

SCIENCE

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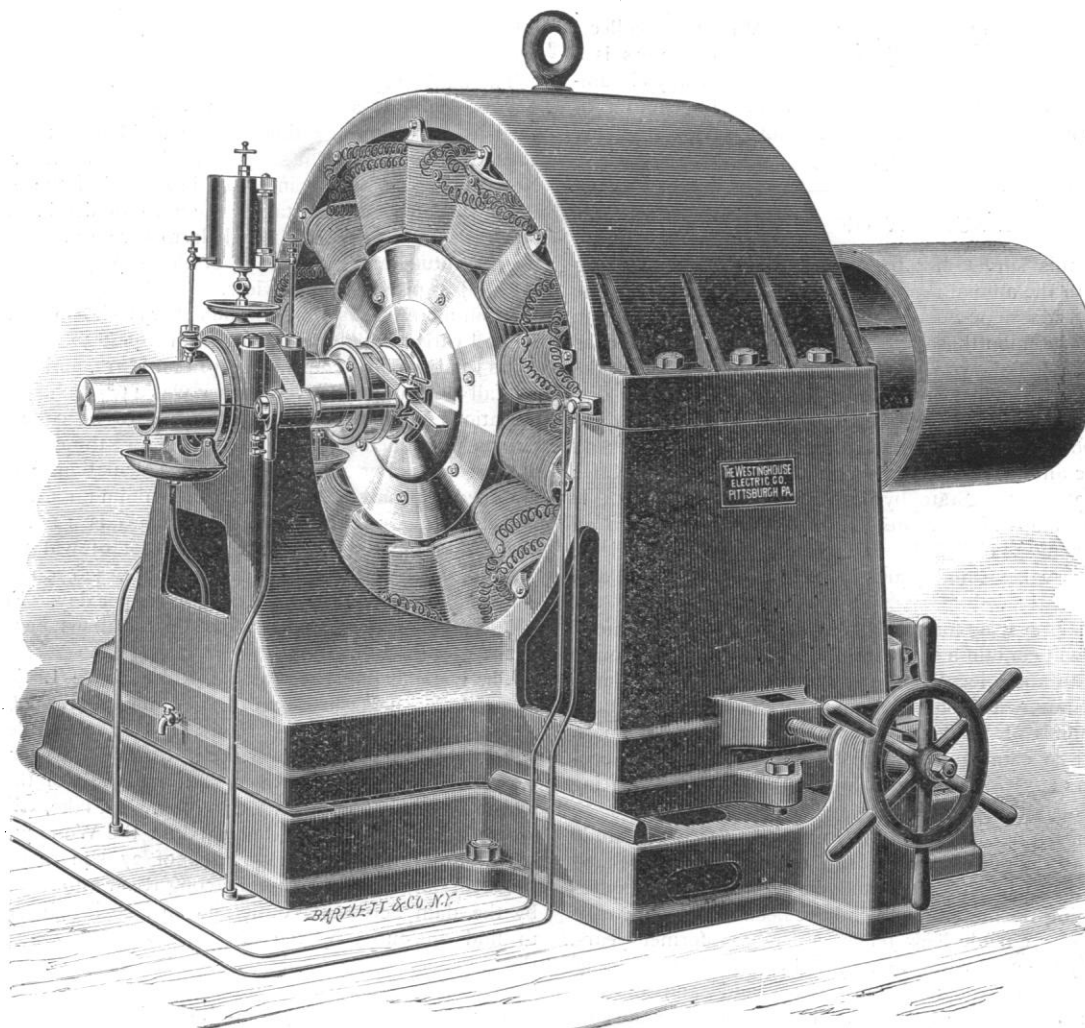
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WESTINGHOUSE ALTERNATING-CURRENT DYNAMO.

THE Westinghouse dynamo for generating an alternating current is shown in the accompanying illustration. It is apparent at a glance that it is different in principle of construction from the ordinary direct-current machine. The field is composed of a series of radial pole-pieces of alternate polarity, the cores of which are cast solid with the casing or body of the machine. The field-coils

zontal plane through the shaft. The armature may be removed and replaced in similar manner.

The general design of the dynamo is symmetrical, and of a character calculated to give the greatest rigidity in its structure. Oil is fed from the cups to the bearings, and allowed to work freely into the drip-pan, and thence into the tank in the base, whence it may be drawn off at the stop-cock, strained, and returned to the oil-cups, thus permitting thorough lubrication without waste of oil.



THE WESTINGHOUSE 1500-LIGHT ALTERNATING-CURRENT DYNAMO.

are a series of independent bobbins, which are first wound on shells, then slipped over the pole-pieces, and held in place by bolts. These bobbins, being supplied with a feeble current from the exciter, are subject to no natural deterioration, and are not liable to accident. They can only be damaged by carelessness; and, in case one should be so damaged, it may be easily removed and replaced, as the whole structure of the dynamo parts along a hori-

The illustration shows the side of the dynamo which carries the collecting-ring: the other side has a bearing similar to the one shown, beyond which is an overhung pulley made of compressed strawboard, which is found to be an excellent material for the purpose. The machine rests upon a cast-iron base, and is adjustable by means of a belt-tightener. The dynamo may be run in either direction or placed either way around on the base.

The Westinghouse Company at present manufacture five sizes of these dynamos, having capacities ranging from five hundred to five thousand 16-candle-power lights. The machine shown in the cut is the No. 2 dynamo, having a capacity of fifteen hundred lights.

The field-coils in these machines are supplied with current from a separate exciter, which is simply a small direct-current machine. The exciter may be driven by an independent engine, or it may, if desired, be attached to the shaft of the dynamo, in which case the dynamo is said to be self-exciting.

The armature of this dynamo is a structure of great simplicity. The body is of laminated iron plates, freely perforated for ventilating purposes. A single layer of wire is wound in flat coils back and forth across the face of the armature, parallel with the shaft, being held in place by stops on the ends of the armature. Mica and other insulation is provided, and the whole is wrapped with binding-wire. A ventilator is attached to each end of the armature, drawing a strong current of air through, thus insuring a sufficient degree of coolness. These armatures are uniformly wound to deliver a current of a thousand volts, a higher voltage than this for special circuits being obtained when necessary by means of a special converter. The absence of a commutator will be noticed in the illustration, its place being taken by two plain collecting-rings without breaks of any kind. Narrow collectors rest upon these rings, taking off the current as it is generated. With these collecting-rings it is obvious that the adjustment of the collectors is a matter of indifference, as no sparking can occur under any circumstance, there being no interruption of the current. The matter of dust or more or less oil has no effect, the whole device resolving itself into a detail of great simplicity.

GEOLOGICAL SURVEY OF NEW JERSEY.

THE work of this survey has been steadily prosecuted during the past year. In the annual report for 1887 it was stated that the Topographic and Magnetic Surveys of the State were completed, and that the reports upon these would be prepared and printed as rapidly as possible. This work is done, and the first volume of the final report of the Geological Survey of New Jersey is being distributed. It is an octavo volume of 450 pages, and contains a report on the Geodetic Survey by Professor Edward A. Bowser; on the Topographic and Magnetic Surveys, by C. C. Vermeule, C.E.; and on the climate of the State, by Professor John C. Smock. It also contains two maps of the State on a scale of five miles to an inch, — one showing its civil divisions; and the other, its elevations, mountains, ridges, valleys, and plains, together with its rivers and its drainage areas.

The work now preparing for publication as the second volume of the final report will contain a full catalogue of the minerals found in the State, with their localities; a catalogue of all the plants growing in the State, with notes of their occurrence and localities; and also catalogues of its vertebrate and invertebrate animals. Appendices to these catalogues will give some practical and economic particulars regarding them. Most of the work of preparing these catalogues is already done.

So much attention has been given in former reports to the study and description of the geological structure of the rocks of the State, that the work still to be done is mainly in combining and systematically arranging the materials which have been collected by various persons who have made New Jersey a study in former years. This is especially the case with the marl and clay formations in the middle of the State, and the limestones, slates, and sandstones in the north and north-western portions. There are some obscure and difficult points of structure in the red sandstone and the gneissic rocks; but it is thought that important progress has been made in clearing up these difficulties, and that the volume on structural geology can be prepared as soon as that above mentioned is out of the way, and that one on the economical geology can then properly complete the series.

The prompt publication and liberal distribution of the results of the State surveys have continued to meet the approval of the citizens, and to supply suggestive and needed information. The expenses of printing, mailing, and expressage are large; but the

returns in the development and wealth of the State abundantly justify the expenditure. The whole system of artesian well-boring was started at the direct suggestion of the survey, and it has brought inestimable sanitary and pecuniary benefits to the whole Atlantic coast, and has been of great service throughout the State. The description of the location and structure of our fire and potters' clays, and its publication, have caused the development of some of the best clay properties in the country, and have made public the immense stores of the best plastic and refractory materials in the immediate vicinity of the great manufactories and markets of the continent. The preparation and publication of the topographic maps, in advance of those of any other State, have tended to draw attention to the peculiar advantages of New Jersey in its location, its varied surface, its healthful seaside and mountain resorts, its water-supply, and its unequalled means of travel and communication. The maps are studied by engineers for projected improvements, by citizens seeking homes in the country, by land-owners who desire to improve or open their properties, as well as by intelligent and inquiring citizens of all kinds who are interested in the development and prosperity of the State. The publication of the condition of the mines, quarries, lime-production, marls, drained lands, water-supplies, and other matters of general interest, is continually inciting to new enterprises and the investment of capital; and the notes in regard to soils and the means for their improvement are helping to develop agriculture, and to greatly increase its products.

The public supply of pure and wholesome water to the people of the cities, towns, and villages, is of growing importance; and it needs to be kept before those who should reap the benefits of it. That there are abundant supplies of the best of water to be found in New Jersey, has been pointed out in several of the annual reports. Perhaps that of 1876 contained the most of detail. A bare repetition of some of the points may help to give a more definite idea of the magnitude and importance of the supply, as well as to keep the subject prominently in view.

From many years' observations it was shown that the annual rainfall varied in different years from about 30 inches in the driest years to about 60 inches in the wettest years, and that the average rainfall in all northern New Jersey was $44\frac{5}{16}$ inches per year. Observations upon the amount of water to be collected from the Croton watershed show that 60 per cent of the rainfall runs off in the streams. For purposes of safe calculation, however, it was assumed that only 40 per cent of the minimum rainfall should be depended upon: 40 per cent of 30 inches is 12 inches. From a square foot of surface, then, a cubic foot of water can be saved every year, or $7\frac{1}{2}$ gallons. From an acre, 326,700 gallons can be collected per year, or nearly 900 gallons per day. From a square mile there can be collected 209,088,000 gallons per year, or daily 572,844 gallons.

The watershed of the Passaic River above Little Falls is 750 square miles, being made up of the drainage areas of the following-named streams: Ramapo River, 148 square miles; Wanoque River, 108; Pequannac River, 82; Rockaway River, 165; Whippany River, 59; Passaic River, 188; total area of the Passaic and its branches, 750 square miles. Greenwood lake, with a drainage area of 32 square miles, is included in the Wanoque area. Lake Hopatcong, with a drainage area of 27 square miles, naturally found an outlet by the Musconetcong River into the Delaware; but, by the dam across its outlet, its surface has been raised so as to find an outlet by the Morris Canal into the watershed of the Passaic. The total area to be drawn from is, then, 777 square miles. This area can be depended upon to supply 500,000,000 gallons of water daily. At Little Falls, all this water is in one stream, at an elevation of 158 feet above mean tide; and it is only 16 miles from the centre of Newark, and 22 miles from the centre of Jersey City, or only about half the distance from which the Croton water is carried to New York. By going a few miles farther up the streams, most of the water could be collected at an elevation of 250 feet, or high enough to supply all of those cities by gravity.

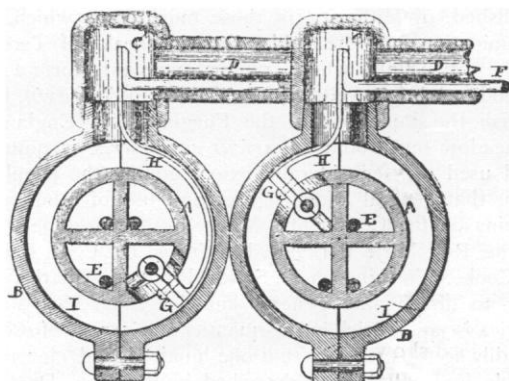
The quality of this water is unquestionable in purity. It is mostly gathered from a country which is mountainous, mostly in forest, and likely to remain so for a long time to come. As a substitute

for the filthy water supplied to almost half the people of the State, it is of incalculable value, and there should be no delay in securing its health-giving benefits.

The artesian wells bored at various points on the Atlantic coast between Sandy Hook and Cape May continue to yield a supply of good and wholesome water, and some very satisfactory ones have been sunk along the Delaware.

THE MEDBERY UNDERGROUND SYSTEM.

WE have to record this time another instance of the moving in cycles of human progress. As the first water-pipes for distributing water through towns were made of wood, to be afterwards made of iron and iron and cement, so now an inventor has produced a wooden pipe, not necessarily for use in conveying water, but more especially for use as a conduit for electric conductors. This pipe is made from long wood fibres, separated, washed free from saps and gums, and then moulded while in a pulpy state into the requisite size and shape, being subjected to great hydraulic pressure. After this it is treated and hardened by a chemical process, that, it is believed, renders it impervious to moisture, acids, or gas. The piping looks not unlike iron, but is, of course, much lighter, and is made in sections which can be joined by threads, like iron pipes, with a sleeve coupling. The pipes can be made continuous, thus preventing gases or moisture coming in contact with the enclosed wires. Each conduit is divided into four or more compartments,

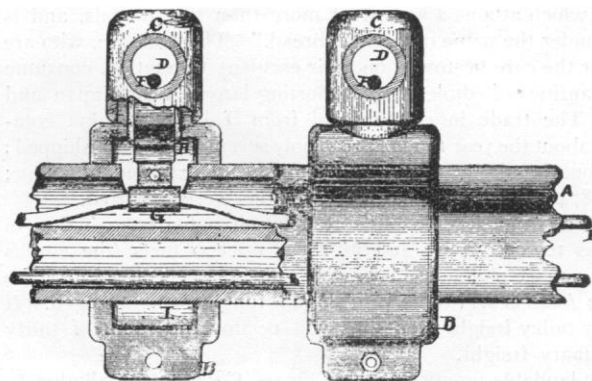


being properly cemented. The branch wire is then connected with the extension from the clamp *H*, and, when it has been passed through the first length of the branch conduit *F*, the branch conduit is screwed into the threaded hole in the side of the cap *C*, or, preferably, cemented into place. The branch line can thus be extended as far as may be desired. Thus far in the process, connection has been made with one wire only, either the negative or the positive wire, but of course the connection with the other wire will be made in a similar manner.

The system as above outlined is being introduced by the American Indurated Fibre Company of Mechanicsville, N.Y., from whom further information may be obtained. It may be mentioned that satisfactory practical work with it has been done by the Bell Telephone Company of Philadelphia, the Pennsylvania Railroad Company, and other parties.

EDIBLE MUSHROOMS OF THE UNITED STATES.

FOR several years past the division of microscopy of the United States Department of Agriculture has been in receipt of numerous letters from regular correspondents and others, from which it appears that in various localities, representing almost every section and climate of the Union, there are found large quantities of edible mushrooms and other allied fungi; few of which, however, are utilized, owing to the inability of the great majority of the people to distinguish the edible species from the poisonous ones. To ob-



FIGS. 1 AND 2.—THE MEDBERY UNDERGROUND SYSTEM.

as shown in the illustrations; and the wires occupy separate ducts, which precludes the possibility of cross-circuits. The question of insulating wires is one of considerable importance, and the expenditure is necessarily very great; but in this conduit, by reason of the high insulating power of the material, expensive insulation of the wires is avoided.

Another noteworthy feature of this system is the method of distributing to houses and street-lamps. Usually it is necessary to make provision for this when laying the conduit, which is necessarily very expensive; but by this system side taps and connections can be as easily made at any time after the conduit is laid, and without serious expense, as will be explained from the accompanying illustrations, Figs. 1 and 2.

When desiring to make connection with the main line, the conduit is exposed at any point, and an opening is cut in it in any preferred manner. It is usually drilled. The wire is then lifted from its resting-place in the conduit, through the hole in the conduit; and the two parts of the metallic clamp *G*, being first separated, are put over the wire, and firmly attached thereto by means of a screw. The clamp has a chamber into which a suitable metal or solder is melted or fused, making a perfect contact and permanent joint. The two sides of the casing or connecting box (which, it will be seen, has a recess or hollow interior) may be filled with suitable insulating-cement while in a plastic state, and they are then placed about the conduit in such a manner that the extension of the clamp *H* projects through the neck of the casing, as shown in the cut. The bolts are then inserted in the lips of distributing-duct *B*, and screwed up. The cap *C* is then applied, and forced firmly down upon the tapering neck of the casing, after

tain some clear and trustworthy criteria by which to make this essential distinction has been the object of the various communications received; and in view of the highly nutritious properties of this class of esculents, and of the great possible value of their aggregate product as indicated by the vast quantities produced in countries where attention is given to their cultivation, the importance of a satisfactory answer to these inquiries will be readily appreciated. This answer is given in a little pamphlet on twelve edible mushrooms of the United States, illustrated with twelve colored types, by Thomas Taylor, M.D., microscopist of the Department of Agriculture, Washington, D.C.

Rollrausch and Siegel, who claim to have made exhaustive investigations into the food-values of mushrooms, state that "many species deserve to be placed beside meat as sources of nitrogenous nutriment;" and their analysis, if correct, fully bears out the statement. They find, in 100 parts of dried *Morchella esculenta*, 35.18 per cent of proteine; in *Helvella esculenta*, 26.31 per cent of proteine, from 46 to 49 per cent of potassium salts and phosphoric acid, 2.3 per cent of fatty matter, and a considerable quantity of sugar. The *Boletus edulis* they represent as containing in 100 parts of the dried substance 22.82 per cent of proteine. The nitrogenous values of different foods, as compared with the mushroom, are stated as follows: "proteine substances calculated for 100 parts of bread, 8.03; of oatmeal, 9.74; of barley-bread, 6.39; of leguminous fruits, 27.05; of potatoes, 4.85; of mushrooms, 33.0." A much larger proportion of the various kinds of mushrooms are edible than is generally supposed, but a prejudice has grown up concerning them in this country which it will take some time to eradicate. Notwithstanding the occurrence of occasional fatal ac-

cidents through the inadvertent eating of poisonous species, fungi are largely consumed, both by savage and civilized man, in all parts of the world; and, while they contribute so considerable a portion of the food-product of the world, we may be sure their value will not be permanently overlooked in the United States, especially when we consider our large accessions of population from countries in which the mushroom is a familiar and much-prized edible.

In France mushrooms form a very large article of consumption, and are widely cultivated. Mushroom-beds are cultivated in caves, frequently miles in extent. A cave at Mery is mentioned as containing, in 1867, twenty-one miles of beds, and producing not less than three thousand pounds daily. Another at Frepillon contains sixteen miles of beds. The catacombs and quarries of Paris and vicinity, and the caves of Moulin de la Roche, Sous Bicetre, and Bagneux, produce immense quantities of mushrooms. They are all under government supervision, and are regularly inspected, like the mines.

The mushroom which is cultivated in these quarries and caves, almost to the exclusion of all others, is the "Snow-Ball" (*Agaricus arvensis*). The truffle is held in high esteem, and is largely exported. In 1872 the quantity of truffles exported from France was valued at over 3,000,000 francs; in 1879, at nearly 10,000,000 francs. Immense quantities of the *Agaricus deliciosus* are sold in the Marseilles markets. The *Fistulina hepatica* is also in great demand, and many other varieties appear from time to time in the markets throughout France. The natives of Australia use largely a truffle which attains a weight of more than two pounds, and is known under the name of "native bread." The Chinese, who are noted for the care bestowed on their esculent vegetation, consume large quantities of edible fungi, importing largely from Japan and Tahiti. The trade in edible fungi from Tahiti to China commenced about the year 1866; in 1868 only seventy tons were shipped; in 1873 one hundred and thirty-five tons were exported to China; and in 1874 one hundred and fifty-two tons were exported.

The value of mushrooms imported by Shanghai from Tahiti in 1872 was 107,000 taels; and in 1873, 138,800 taels (the tael is worth about six shillings sterling). The fungus shipped, *Exidia auricula Indæ* is said to be very rich in fungine and nitrogen. It is a very bulky freight: ten tons will occupy the room of thirty tons ordinary freight.

A very laudable practice of the Chinese Government alluded to in an English journal, and which might perhaps be advantageously adopted in this country, is the publishing, for annual gratuitous distribution, of numerous treatises describing the different herbs which can be utilized in whole or in part for food-purposes. One of these treatises is called the "Anti-Famine Herbal," and consists of six volumes, containing descriptions, with illustrations, of over four hundred plants which can be used as food. These volumes are of inestimable value in districts where the ravages of insects, drought, etc., have destroyed the grain and rice crops, and famine is imminent. For some years past New Zealand has exported large quantities of an edible fungus to San Francisco and Hong Kong for the use of the Celestials. A full account of this industry may be obtained from the United States consular reports. The gathering and drying of the fungus gives profitable employment to large numbers of colonial children, as well as to the Maoris. The species grows abundantly in the wooded regions of New Zealand, and when dry is worth from fourpence to fivepence a pound. The Chinese, who are singularly free from prejudice in the matter of food, use it, as they do the edible swallow's nest, as a chief ingredient in their favorite soup. They also employ it as a medicine, and, stranger still, for making a valuable dye for silk. Another remarkable edible fungus of New Zealand is the *Sphæria Robertsii*, which grows out of the body of a large caterpillar, practically converting the latter into vegetable substance. The caterpillar lives under ground, and the fungus springs upwards through the soil till it reaches a height of eight or ten inches. It is eaten by the Maoris, who employ it also, when burned, as a coloring-matter.

The Japanese grow several species of edible fungi in logs of decaying wood in a manner peculiar to themselves; and, aside from the home consumption, they in one year exported to China mushrooms to the value of \$60,000. In 1879 mushrooms were exported

from Japan to the value of 243,440 yens. The yen is equal to 99 $\frac{1}{10}$ cents. Among the north-eastern tribes of Asia, fungi are largely used as food. One species, when pounded, forms their snuff; while another, the *Fly Agaric*, which is utilized in Europe as a fly-killer, and is regarded as one of the most poisonous forms, is used by them as a substitute for ardent spirits, one large specimen being sufficient "to produce a pleasant intoxication for a whole day." In many parts of Europe fungi are a favorite food, being eaten fresh, and also preserved in vinegar for winter use. For pickling purposes, all kinds, it is said, are gathered, the vinegar being supposed to neutralize the alkaline poison of the noxious species. The common mushroom, the morel, and the truffle, are, however, the favorite edible fungi. In Italy the value of the mushroom as an article of diet has long been understood and appreciated. Pliny, Galen, and Dioscorides mention various esculent species, notably varieties of the truffle, the boletus, and the puff-ball. At Rome it has been the custom of the government to appoint inspectors to examine all the mushrooms brought into market, and to reject such as are poisonous or worthless, which are thrown into the Tiber. It was required also that no mushrooms should be hawked about the streets, but that all should be sent to the central depot for inspection.

The yearly average of the taxed mushrooms sold (all over ten pounds being taxed) in the city of Rome alone, for the past decade, has been estimated at between sixty thousand and eighty thousand pounds weight. Large quantities of mushrooms are consumed in Germany, Hungary, Russia, and Austria, and in the last country a list is published, by authority, of those mushrooms which, upon official examination, may be sold. Darwin speaks of Terra del Fuego as the only country where cryptogamic plants form a staple article of food. A bright yellow fungus allied to *Bulgarin*, forms, with shell-fish, the staple food of the Fuegians. In England the common meadow mushroom, *Agaricus campestris*, is quite well known, and used to a considerable extent among the people, but there is not that general knowledge of and use of other species which obtains on the Continent. Much has been done of late years by the Rev. M. J. Berkeley, Dr. Curtis, Dr. C. D. Badham, Dr. M. C. Cooke, Worthington G. Smith, Professor Charles Peck, and others, to disseminate general knowledge on this subject. That America is no less rich in the quantity and variety of esculent fungi is readily seen by the fact that one hundred and eleven species of edible fungi have been described by the Rev. Dr. Curtis, State botanist of North Carolina, as indigenous to that State alone, and late investigations show that nearly all the species common to the countries of continental Europe are found in different localities in the United States. Dr. J. J. Brown of Sheboygan, Wis., writes that edible mushrooms are found in his neighborhood in great abundance.

Many methods of cultivating the common meadow mushroom have been presented by different growers, but all agree as to the value of the general methods in practice. Nearly every farm and nursery affords the conditions necessary to cultivate the ordinary field-mushrooms; such as sheltered sheds, stables, and small hot-beds for winter cultivation, and melon-patches, cucumber-pits, etc., for summer culture.

Mushroom spawn in "bricks" can be easily obtained from the seedsmen. Natural or virgin spawn, which is considered by many experienced growers as preferable to the artificial, can be obtained in most places where horses are kept. It is found in half-decomposed manure-heaps, generally where horse droppings have accumulated under cover. It is readily distinguished by its white filamentous character and by its mushroom odor. When dried, it can be kept for years.

Mushroom-beds are easily formed on the floors of sheds by carrying in the fresh stable-dung, adding to it about one-fourth of good loam, mixing both together, pressing firmly down, and letting the mass remain about two weeks untouched. By this time the temperature will be on the decline; and when it falls anywhere between 50° and 60° F., break the spawn bricks into pieces two inches square, and plant twelve inches apart, three inches below the surface. By means of any suitable instrument, beat the mass down firmly, then add three inches of good soil, and beat again.

For culinary purposes, mushrooms should generally be allowed a

growth of about six weeks, and when gathered should be carefully cut off with a knife, not broken.

It is recommended that mushroom-beds should not be finally earthed until the spawn is seen beginning to spread its white filaments through the mass; and should it fail to do this in eight or ten days after spawning, the conditions being favorable, it is better to insert fresh spawn or to remake the bed, adding fresh materials if it be found to fail from being too cold. The temperature of the beds at spawning-time should not exceed 80° F.: 70° F. is considered the most suitable regular temperature. It is advisable not to put the spawn at any uniform depth, but so that while one piece of it may be at a depth of six inches, or nearly so, others may touch the surface. This allows the spawn to vegetate at a depth and temperature most congenial to it. Mushrooms may be cultivated in warm cellars, in boxes about four feet square by eighteen inches in depth, for family use.

MINERAL PRODUCTS OF THE UNITED STATES.

THE sixth report on "The Mineral Resources of the United States," by David T. Day, chief of the division of mining statistics and technology, United States Geological Survey, is to be issued shortly. This report is for the calendar year 1888, and contains detailed statistics for this period, and also for preceding years, together with much descriptive and technical matter. The following are the totals of the production of the more important mineral substances in 1888:—

Metals.

Iron and Steel.—The principal statistics for 1888 were: domestic iron ore consumed, about 12,060,000 long tons; value at mines, \$28,944,000. This is an increase over 1887 in quantity of 760,000 tons, but a decrease in value of \$4,956,000. Imported iron ore consumed, 587,470 long tons; total iron ore consumed in 1888, about 12,650,000 long tons, or 150,000 tons more than in 1887. Pig-iron made in 1888, 6,489,738 long tons; value at furnace, \$107,000,000. This is an increase over 1887 of 72,590 tons in quantity, but a decrease of \$14,925,800 in value. Steel of all kinds produced in 1888, 2,899,440 long tons; value at works, \$89,000,000. This is a decrease from 1887 of 439,631 tons in quantity, and of \$14,811,000 in value. Total spot value of all iron and steel made in 1888, in the first stage of manufacture, excluding all duplications, \$145,000,000, a decrease of \$26,103,000 as compared with 1887. Limestone used as a flux in the manufacture of pig-iron in 1888, about 5,438,000 long tons; value at quarry, about \$2,719,000.

Gold and Silver.—According to the director of the mint, the gold product was 1,604,927 fine ounces, valued at \$33,175,000. This is about the same as in 1887, being an excess of only \$75,000. The silver product was 45,783,632 fine ounces, of the commercial value of about \$43,000,000, and of the coining value of \$59,195,000. This is an increase of 4,515,327 ounces over the product in 1887. In addition to the product of our own mines, some 10,000,000 ounces of silver were extracted in the United States from foreign ores and bullion.

Copper.—The total product, including the yield of imported ores, increased to 231,270,622 pounds, or 115,635 short tons, during 1888, which is 46,053,291 pounds more than the product of 1887. During the first quarter of 1889 the production was increasing at even a more rapid rate. The prices received by American producers averaged 15.5 cents per pound for Lake copper, 14.5 for Arizona, and 14 for other districts, making the total value 33,833,934. Montana led in the production, making 97,897,968 pounds. Consumption was somewhat reduced by the high prices.

Lead.—The product increased to 180,555 short tons from 160,700 tons in 1887. The increase was due principally to the heavier receipts of lead in Mexican silver-lead ores from 15,000 tons in 1887 to over 27,000 tons in 1888. The average price in New York was 4.41 cents per pound. The production of white lead, chiefly from pig-lead, was 89,000 short tons, valued at \$10,680,000.

Zinc.—The erection of new works and the extension of old ones led to a further notable increase in the production of zinc in 1888. The additions to capacity were fairly uniformly distributed in the

West, East, and South. Production in 1888, 55,903 short tons, with a total value of \$5,500,855; in 1887, 50,340 tons, worth \$4,782,300. The production of zinc white in 1888, directly from ores, was 20,000 short tons, worth \$1,600,000.

Quicksilver.—The product was 33,250 flasks (of 76½ pounds each) from California, a decline in that State of 510 flasks from 1887, in spite of a very satisfactory price, which averaged \$42.50 per flask, making the total value \$1,413,125. No new valuable deposits were discovered in 1888, and without them it is not probable that the yield of quicksilver will increase.

Nickel.—The industry remains unchanged except for indications of further developments at Lovelock in Nevada, and Riddle in Oregon. The product includes 190,637 pounds of metallic nickel, valued at \$114,382 at 60 cents per pound, and 4,545 pounds, worth \$1,136, exported in ores and matte. Total value, \$115,518. The corresponding value in 1887 was \$133,200.

Cobalt Oxide.—The total product, including the contents of the exported ores and matte, was 12,266 pounds, worth \$18,441. In 1887 the total was 18,340 pounds, worth \$18,774, the lower rate of value in that year resulting from a larger proportion of exported nickel in matte and ore. The price of cobalt oxide remained at \$2 per pound.

Chromium.—The product declined from 3,000 tons in 1887 to 1,500 tons in 1888. The average price in San Francisco remained \$15 per ton. Increased operations are probable in 1889.

Manganese.—The product of manganese and manganiferous iron ores in the United States in 1888 was 239,460 tons, valued at \$876,215. Of this amount, some 25,500 tons would be classed as manganese ores; the remainder, as manganiferous iron ores. Of the manganiferous iron ores, 11,462 tons averaging 11 per cent of manganese, and 189,574 tons averaging 4 per cent of manganese, were from the Colby Mine, Michigan. In addition to the above, some 60,000 tons of argenteous manganese ores, valued at \$10 a ton, chiefly for the silver contained in them, were produced in the Rocky Mountain region.

Aluminum.—The past year was more promising than ever before for the production of cheap aluminum. The production of metallic aluminum as an industry distinct from the production of alloys began toward the close of the year, and 500 pounds had been made up to Dec. 31. The production of 3,000 pounds since then indicates that the industry may continue. The exact amount of alloys produced by the Cowles process has not been furnished, but was not markedly different from the product of 1887, when 18,000 pounds of aluminum contained in bronze and ferro-aluminum were produced. The price for metallic aluminum declined to as low as \$4.50 per pound for less favored brands.

Platinum.—Including the platinum and iridium separated from gold by the assay offices and that saved in placer gold-mining, the product was about 500 ounces, valued at \$2,000.

Fuels.

Coal.—The total production of all kinds of commercial coal in 1888 was 142,037,735 short tons (increase over 1887, 18,022,480 tons), valued at the mines at \$204,221,990 (increase, \$30,625,994). This may be divided into Pennsylvania anthracite, 43,922,897 short tons (increase, 4,416,642 short tons), or 39,216,872 long tons, including 38,145,718 long tons shipped by the railroads and canals and reported by their statistician, Mr. John H. Jones, and 1,071,154 long tons sold to the local trade at the mines (increase, 3,943,430 long tons), valued at \$85,649,649 (increase, \$6,284,405); all other coals, including bituminous, brown coal, lignite, small lots of anthracite produced in Colorado and Arkansas, and 4,000 tons of graphitic coal mined in Rhode Island, amounting in the aggregate to 98,114,838 short tons (increase, 13,605,838 tons), valued at \$118,572,341 (increase, \$24,341,589).

The colliery consumption at the individual mines varies from nothing to 8 per cent of the total output of the mines, being greatest at special Pennsylvania anthracite mines, and lowest at those bituminous mines where the coal-bed lies nearly horizontal, and where no steam-power or ventilating-furnaces are used. The averages for the different States vary from 2 to 6.4 per cent; the minimum average being in the Pennsylvania bituminous, and the maximum average being in the Pennsylvania anthracite region.

The total output of the mines, including colliery consumption, was Pennsylvania anthracite, 41,624,610 long tons (increase over 1887, 4,045,863 long tons), or 46,619,564 short tons (increase, 4,531,367 short tons); all other coals, 102,039,838 short tons (increase, 14,152,478 tons); making the total output of all coals from mines in the United States, exclusive of slack coal thrown on the dumps, 148,659,402 short tons (increase, 18,683,845 tons), valued as follows: anthracite, \$89,020,483 (increase, \$4,468,302); bituminous, \$122,497,341 (increase, \$24,492,685); total value, \$211,517,824 (increase, \$28,960,987). The above figures show a notable increase in 1888 over 1887 in the aggregate output and value of both anthracite and bituminous coal, although not as great an increase as occurred in 1887 over 1886 in the value of the anthracite, or in the total tonnage of the bituminous coal.

Coke.—The production of coke in the United States in 1888 was 8,527,560 tons, valued at about \$14,000,000. Pennsylvania produced by far the largest amount, the Connellsville region alone producing 4,955,553 tons; West Virginia, 528,533 tons; Alabama, 518,511 tons; Tennessee, 385,693 tons; and Virginia, 149,099 tons.

Petroleum.—The product of petroleum in the United States in 1888 was 27,346,018 barrels (of 42 gallons each), valued at about \$24,598,559. Of this amount, Pennsylvania produced 16,491,083 barrels; Ohio, 10,010,868 barrels; West Virginia, 119,448 barrels; California, 704,619 barrels; and other States, 20,000 barrels.

Natural Gas.—The amount of natural gas consumed is given in coal displacement; that is, the amount of coal displaced by the use of natural gas. It is estimated that the amount of coal displaced by natural gas in the United States in 1888 was 14,163,830 tons, valued at \$22,662,128. Of this amount, 12,543,830 tons were displaced in Pennsylvania, 750,000 tons in Ohio, and 660,000 tons in Indiana.

Structural Materials.

Building-Stone.—Direct returns from producers of the various kinds of building-stone show that there was but a small gain in value over the figures of 1887. The value of the stone produced in 1888 is \$25,500,000, or \$500,000 more than in the preceding year.

Brick and Tile.—Value, \$48,213,000. This figure represents only a small gain over 1887. This is due rather to increase in the number of manufacturing plants than to increased production at the older and more important sources of supply; in fact, many of the latter show a falling-off in production. Prices also were generally somewhat lower than in 1887.

Lime.—The production is estimated at 49,087,000 barrels, with an average value of 50 cents per barrel, making a total of \$24,543,500 as the value of the year's product. These figures are not largely in advance of those for 1887, and the gains are not so much the results of increased production in the leading lime regions as in localities of minor importance.

Cement.—The amount of cement produced in 1888 is less than for 1887, being 6,253,295 barrels for 1888, valued at 72.5 cents per barrel, making \$4,533,639 as the value of the year's product.

Abrasive Materials.

Buhrstones.—The product which is used for grinding cement, plaster, paints, feed, etc., comes from New York, Pennsylvania, and North Carolina, and is valued at \$150,000.

Grindstones.—Ohio and Michigan furnish practically all the sandstone from which grindstones are made. The product in 1888 increased slightly; 41,000 long tons, worth \$281,800, being produced, against 37,400, worth \$224,400, in 1887. The price varied from \$6.50 to \$10 per ton at the quarries before being finished into grindstones.

Corundum.—Production is limited to the old mines in North Carolina and Georgia: 589 short tons, valued at \$91,620, were produced in 1888 against 600 tons in 1887.

Oilstones and Whetstones.—The production of novaculite from Arkansas increased slightly, making the total, including Labrador oil-stone, etc., 1,500,000 pounds, valued at \$18,000 in the rough state.

Miscellaneous.

Precious Stones.—No systematic mining was carried on in search of gems in 1888; but in mining for other substances, and in chance discoveries, gems worth \$64,850 in the rough state, and gold quartz worth \$75,000, were found.

Phosphate Rock.—The production declined to 433,705 long tons, but the total value increased slightly to \$1,951,673 on account of better prices. The trade in manufactured fertilizers was very prosperous.

Marls.—The production in the Southern States, particularly in Virginia, North Carolina, Alabama, Mississippi, and Florida, is increasing, while the product of New Jersey did not vary from 1887. About 600,000 tons, valued at \$300,000, were produced.

Salt.—The industry shows only slight changes. In 1888 the production was 8,055,881 barrels of 280 pounds, valued at \$4,377,204. In 1887 the product was 8,003,962 barrels, worth \$4,093,846. Kansas became a commercial source of salt in 1888, producing 155,000 barrels, with a prospect of still greater increase in 1889.

Bromine.—The product was 307,386 pounds, worth \$95,290, an increase from 199,087 pounds in 1887, worth \$61,717. The price remained at 31 cents per pound.

Borax.—The production was restricted to 7,589,000 pounds, worth \$455,340, at 6 cents per pound for the average quality. In 1887 the product was 11,000,000 pounds, worth 5 cents per pound.

Sulphur.—The sulphur-refinery in Utah was partially burned. This and litigation over the property prevented any production in 1888. The supply came principally from Sicily, with small importations from Japan. It was practically all made into sulphuric acid.

Pyrites.—Production, 54,331 long tons, valued at the mines at \$167,658, a slight increase in quantity over the previous year.

Barytes.—The production from Missouri, Virginia, and New York increased to 20,000 long tons, worth at the mines \$110,000. In 1887 the product was 15,000 long tons, worth \$75,000.

Gypsum.—The domestic supply comes principally from Ohio and Michigan, with smaller amounts from New York, Virginia, Kansas, Colorado, California, Dakota, and Utah. The product in 1888 was 96,000 short tons of crude gypsum, valued at \$430,000. A large portion of the supply is imported from Nova Scotia, where 126,118 tons, worth \$121,579, were produced in 1888.

Ozocerite.—From the region of Soldier's Summit, Utah, about 20,000 pounds of crude mineral wax were produced, worth \$1,000 in New York, where the material was sold. An increase is probable in 1889.

Soapstone.—Production about 15,000 tons, worth \$50,000 before shipment.

Asphaltum.—The product of 1888 includes 700 tons of gilsonite mined in Utah; 3,100 tons of ordinary asphaltum, principally from California; and 50,000 tons of bituminous rock quarried in California for pavements in competition with asphaltum; total value, \$331,500.

Felspar.—The consumption for potters' use declined to 8,700 long tons, worth, in Trenton, N.J., \$50,000. In 1887, 10,200 long tons were produced, worth \$56,100.

Flint.—For potters' use the consumption was 16,250 long tons. Including that for sandpaper and for glass, the consumption was about 30,000 tons, worth, unground, \$175,000.

Potters' Clay.—The consumption included 18,000 long tons of kaolin or china-clay, 5,250 tons of ball-clay, and 13,500 tons of fire-clay, worth altogether \$300,000.

Mica.—Owing principally to the use of smaller sizes in stoves, the production of sheet mica decreased from 70,500 pounds in 1887 to 48,000 in 1888, valued at \$70,000. There is increased demand for mica waste.

Mineral Paints.—The product, including ochre, metallic paints, and small amounts of umber and sienna, increased to 24,000 long tons, valued at \$380,000.

Graphite.—The production of pure graphite was limited to Ticonderoga, N.Y., and is reported as unchanged. The total production of pure material was 400,000 pounds, worth \$33,000. Small amounts of less pure material for foundry facings, etc., were produced in North Carolina, and at Cranston, R.I.

Fluorspar.—The production limited to the neighborhood of

Roseclare, Ill., and Evansville, Ind., is reported at 6,000 tons, worth \$30,000, an increase of 1,000 tons over 1887.

Infusorial Earth. — The product came principally from Maryland, and amounted to 2,500 short tons, worth, before shipment, \$12,500.

Zircon. — During 1887 and 1888, 25 tons of zircon were mined, principally in Henderson County, N.C., and sold for \$10,000 for the manufacture of incandescent gas-burners. About 4 tons of monazite, 1 ton of allanite, 600 pounds of samarskite, and \$500 worth of yttrium minerals were produced for the same use. About 6 tons of monazite and 5 tons of cerite were also imported.

Mineral Waters. — Amount sold in 1888, 9,628,568 gallons, valued at \$1,709,302. In 1887 the product was 8,259,609 gallons, worth \$1,261,473.

Totals. — The total value of the minerals produced in 1888 was \$591,659,931. It is recognized that this is the sum of the values of substances taken in various stages of manufacture, and hence not strictly comparable with each other; still it is the most valuable means for comparing the total products of different years. The result is an increase of nearly \$50,000,000 beyond the value of the product in 1887. In that year nearly every mineral industry showed an increase, and hence an increased total was evident. But the fact that the increase was so very large was due to rather exceptional conditions in a few important industries, and it could not reasonably be expected that a similar combination of circumstances would result in even a larger total value for 1888. Nevertheless the unprecedented stimulus given to the production of copper by an artificial price increased the total value of that product nearly \$13,000,000, or nearly enough to offset the decline in the total value of pig-iron. The other important factors in the increase were coal and the other fuels, which followed the increased quantity of metals. With the anticipated decline of copper to the normal demand, a decline in the total value of the product in 1889 will not be inconsistent with the natural development of our mineral resources.

THE RAINFALL OF THE PACIFIC SLOPE.

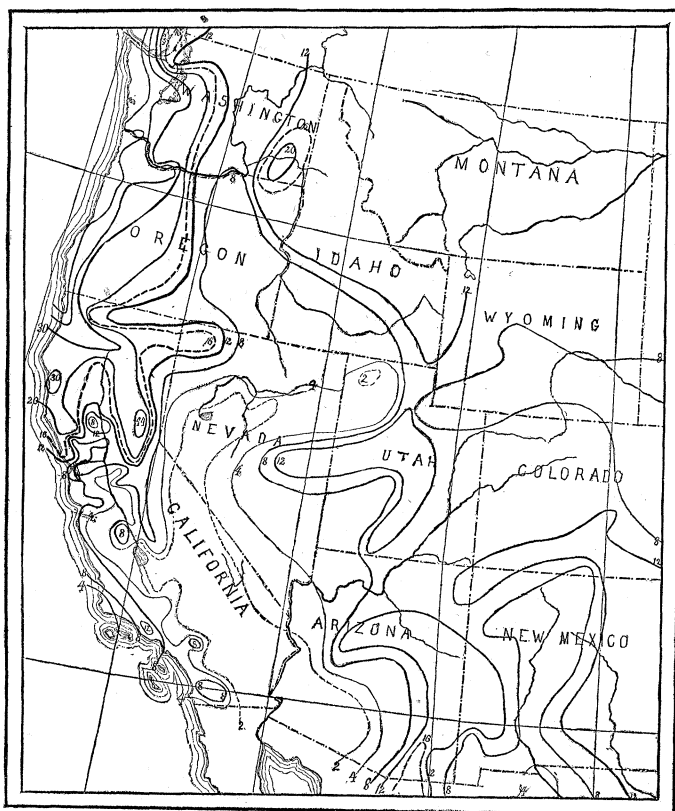
GEN. A. W. GREELY, in compliance with the resolution of the Senate, dated Jan. 4, 1888, has compiled an interesting report on the maximum annual, minimum annual, and on the mean precipitation for each month of the year, for the Western States and Territories, the main part of which is a series of charts. The record from which these charts have been compiled aggregates 4,800 years for 661 stations, thus giving an average of seven years and three months to each station. The separate records, however, vary from two to forty years in length. The principal object of the report is to clear up the important question of the extent of the arid lands. Regarding this point, the chief signal officer says, —

"One great result which must redound to the benefit of the trans-Mississippi and trans-Missouri country by the publication of these official data will be the dispelling of erroneous and injurious impressions which have long prevailed regarding this region. In the early part of this century this territory was viewed as hardly suited for civilized man; its enormous plains and vast mountains being represented as arid and desert regions, unsuited for cultivation, and in many places even unfit for pasturage. Adventure, exploration, and circumstance have pushed the frontier westward, until the myths of the Great American Desert to the north, and of the rainless 'staked plains' to the south, have practically disappeared. It is none the less true, however, that the latest and most reliable text-book of meteorology of this country speaks of the areas between the Sierra Nevada and the Rocky Mountains, including portions of Utah, New Mexico, and California, as a region which is almost entirely destitute of rain, and that farther on the east side of the Rocky Mountains the country is a barren desert, almost without rain.

"As to the value of these charts, there should exist no reasonable doubt, since they not only show prospective settlers in these States and Territories the probable rainfall conditions, but likewise show it to parties contemplating industrial, agricultural, stock, and other investments in these extensive regions. It is evident to all, however, that the rainfall conditions for separate years vary quite considerably; and, indeed, the opinion has been put forth that

these variations are not only enormous, but are so irregular as to render their prediction impracticable, and even that rain does not fall for years in certain sections.

"An examination of the charts of maximum annual rainfall and minimum annual rainfall of these regions shows clearly that rainfall conditions are considerably more equable than has been generally believed; so that the isohyetal lines are quite as regular on these charts of maxima and minima conditions as on those of average conditions. The minimum rainfall has never reached zero for any year, and annual or seasonal rainfalls less than one inch have occurred in south-western California and south-western Arizona at few stations only. These maps of maxima and minima precipitation must be of great practical value as showing the settler or investor exactly the extreme conditions which he must expect to experience in these regions. Another great value of the charts is the bringing to general attention and consideration very extensive areas of country in what has been known as the arid region, where late



LEAST ANNUAL RAINFALL ON THE PACIFIC SLOPE.

and careful observations have shown the rainfall to be far greater than has been usually attributed, and thus transfer these areas to the sub-humid districts.

"The great extent to which misapprehension as to the rainfall conditions of the arid regions has been corrected by these charts is evidenced by the fact that the area on which the mean annual rainfall is less than ten inches, shown on statistical maps of the 'Tenth Census' at 241,000 square miles, has been reduced to 126,000 square miles; while a similar reduction is shown in the area of country where the yearly rainfall is between ten and fifteen inches, which, given in the census chart at 385,000 square miles, is now limited to 259,000 square miles. In other words, the area over which less than fifteen inches of rain fall annually has been reduced almost a quarter of a million (241,000) square miles. A large area of country charted on the statistical map as having an average rainfall of less than five inches now entirely disappears in Texas, New Mexico, Utah, and Oregon, and is materially reduced in Nevada, Arizona, and California.

"Observations over a small, compact agricultural area of South Australia afford very reliable data as to the effect of rainfall upon annual wheat yields. It appears from these observations that

twelve inches of rain in the six winter months produce six bushels of wheat per acre, and that for every increase of rainfall of an inch a like increase occurs in the average production of bushels of wheat per acre."

The minimum rainfall is undoubtedly of the greatest importance to agriculturists, and we reproduce here a portion of the map of minimum rainfall. The point at which a region may be classed as arid, and unfit for successful agriculture, is believed by Gen. Greeley to be fifteen inches. This amount of annual rainfall is not considered sufficient for all crops, nor on all kinds of soil, but may be assumed as an average. Exact observations upon these points are lacking in the United States; but in Australia, observations and experiments have been made, covering now quite a number of years, on wheat, which may be called a test-crop.

The fact that wheat can be grown without irrigation, in a country where the annual rainfall is less than twenty inches, is evidenced by official statistics from Dakota, which show that wheat is grown by tens of millions of bushels yearly in sections where the rainfall ranges from twenty inches downward. In that region over three million bushels of wheat are now grown annually in counties where the rainfall ranges from fifteen and one-tenth down to thirteen and eight-tenths inches.

Perhaps the most careful observations in connection with the effect of rainfall upon pasturage have been made in Australia, the question being very important owing to the immense arid regions in that country. It has been set forth, and probably with a fair degree of authority, that annual rainfall is a most reliable index as to the pastoral capacity of a country, since grass benefits by rain at any season. Australian records show that land favored with less than ten inches of rain a year is quite valueless without irrigation. In such regions only one sheep per square mile can be carried for each inch of rainfall. For from nine to thirteen inches, however, the increase is about twenty sheep per square mile, and for from thirteen to twenty inches of rainfall the increased carrying capacity is about seventy sheep per square mile.

It has been estimated that the sandy land in the San Joaquin valley, California, would feed about one sheep to the acre in its natural state; but when irrigated, and growing alfalfa, it carries twenty.

The question of the amount of minimum rainfall, and of its distribution according to seasons and years, is one of prime importance for the development of the Western States and Territories; and careful and long-continued researches on the meteorological conditions, more particularly on the precipitation, will be of the greatest value to settlers. The chief signal-officer concludes his report with a recommendation to extend observations upon the rainfall in the Western States and Territories by a gratuitous distribution of gauges to reliable voluntary observers who reside in counties from which rainfall reports are not now obtainable.

PRIMARY EDUCATION IN GERMANY.

It is commonly held that in Germany the public-school system, beginning with the university and ending with the primary school, has reached a higher degree of excellence than has been attained anywhere else. The term "Germany" as generally used in this connection is somewhat vague; for the schools are managed differently in different parts, and the various systems are not equally good. In an article in the *Journal of Pedagogy* by O. B. Super of Dickinson College, Carlisle, Penn., a view is given of the system where it has reached its highest excellence.

The first point requiring attention is, that in Germany every thing relating to schools of any kind is done according to a regular system; and this, of course, is a great advantage, to begin with. We sometimes talk of our public school system, but it would be difficult to say what that system is. Ever since there have been white men in America, means have usually been found to give most of the rising generation some kind of an education; and this is about all we can boast of now, for, under the existing order of things, a very large number of children get no education. The census of 1880 shows that we have among us 6,239,958 children who cannot write their names, and this fact alone is enough to prove

that our so-called system comes very far short of doing what it ought to do.

The German Government is careful, first, that suitable buildings are erected for school purposes, and then looks to it that they are provided with proper furniture, books, apparatus, and teachers. Before a new school-building can be erected, the law requires attention to the following particulars: the location must be central; it must be removed from busy streets and noisy or ill smelling factories; the ground must be dry and with sufficient elevation to allow of proper drainage; there must be a dry and clean yard large enough for a play-ground; and the government provides swings, cross-bars, and other appliances for out-door gymnastics. School architecture in America usually depends very much on the character or intelligence of the man who has undertaken the "job." The government further provides the following apparatus for every school: in the primary grades, alphabetical charts, abacus, the metric ruler, two black-boards, a wall-map of the province in which the school is located, a relief-map of Germany, a wall-map of Palestine, and some charts of natural history. In the grammar and high school grades there is much more, including chemical and philosophical apparatus.

But the great point of superiority of their schools lies in the teachers. A good teacher will have a good school in spite of all drawbacks, and a poor teacher will have a poor school in spite of all advantages of building and apparatus. The reason why German teachers, as a rule, are superior to ours, is that the former have been specially trained for their work. With us it seems to be a generally accepted theory that almost any one can teach, provided he knows just a little more than the persons of whom he is to have charge. In Germany, teaching, even in the primary schools, is recognized as a profession, which unfortunately is not the case in this country. Here the average teacher might with propriety be called a sort of "pedagogic tramp;" for in country districts, at least, the same teacher rarely has the same school two successive terms, and the records of some counties in Pennsylvania show that every year more than one-third of the schools have teachers that are entirely without experience, and in many cases they have just "graduated" from the country schools themselves. It will doubtless be found that the same condition of affairs prevails in every State west of Pennsylvania. A very large majority of public-school teachers, if they are men, are only using this occupation as a convenience until they are able to find something more suited to their tastes. If they are women, the probabilities are that in a few years they will marry; and, if they have any thing to do with managing children after that, it will not likely be in the public school. In either case, teaching is looked upon as something one ought to get out of as soon as possible.

In Germany no one is permitted to teach, even in a primary school, unless he has satisfactorily completed the course of study prescribed by the "Teachers' Seminary." Even private schools are subject to the same rigid supervision as the public schools, and no one is allowed to set up a school until he has demonstrated his fitness to teach. With us, private and parochial schools are not seldom worse than the public schools; for, while the former usually have some kind of supervision, the latter have no authorized overseers at all.

In order to be admitted to a "Teachers' Seminary," the applicant must be between sixteen and twenty-four years of age; must have a certificate from his former teacher, testifying to his moral character, good habits, industry, and ability; and must be able to pass an examination in what are usually called "common-school" branches, together with history of Germany, elements of natural philosophy, religious doctrine, and Bible history and music. At the seminary he studies all these, and some higher branches in addition. After completing this course, he must serve two years as assistant to an experienced teacher. If he sustains this ordeal, he is then required to pass a final examination, when he is supposed to be fit to take charge of a low-grade school; but he has now been raised to the rank of a "school-master," is recognized and honored as a member of a noble profession, with a position for life, and a salary that is not large but always sufficient to enable him to maintain his position with respectability, and with the certainty that if he does his work well he will be promoted to the

higher grades of his profession. An examination is necessary before every promotion; so that he must not only teach well, but must keep up with what is going on in the branches which he is required to teach. He teaches about thirty hours a week for ten months of the year, receiving a salary ranging from twenty-five dollars to ninety dollars per month, and a house free of rent. Considering the price of living, this is better compensation than the average American teacher gets. The average salary of the 23,681 teachers in Pennsylvania is \$34.35 per month, and the report from which these figures are taken does not give the lowest salary paid. In some instances it is probably not more than ten dollars a month. As showing the transitory nature of the teacher's occupation in this country, it may be stated, that, of the above twenty-three thousand teachers, over eight thousand had been in the work less than five years. To judge from a statement made some years ago by a prominent Ohio educator, the tenure in that State is still more unstable. Besides, the German village schoolmaster is socially the equal of any of his neighbors, and he and the pastor are the most important personages in the place.

After the German teacher has served ten continuous years, his salary is increased by a small yearly pension; and if he should, on account of age or for any other reason, be unable to continue his labors, his pension is so increased as to afford him a comfortable living. If he dies and leaves a widow, she is pensioned, as are also all children under the age of twelve years whom he may happen to have. The State thus recognizes the teacher in the public school as being of equal value with the soldier; for, if either is disabled in the service, he is pensioned; and if he dies, his family is provided for.

It must not be inferred, from what has been said above, that it is advocated to transfer, as a whole, the German public-school system to the United States. We must make our own system, not borrow one already made. The only object has been to show that in the way of public schools we have more to learn of some European countries than they of us. While it is freely admitted that we have many schools quite as good as any that can be found elsewhere, yet one need only keep his eyes open in order to become fully aware that we have many schools and school-teachers that could not exist under the system sketched above.

DO WARM SUMMERS FOLLOW WARM WINTERS?

ALMOST every newspaper of Boston has recently had something to say about what the weather is to be during the coming summer; and it seems to be an almost unanimous conclusion that the following summer is to be warm because the winter and spring have been warm, or because last summer was cool. This has led Mr. H. H. Clayton to examine the temperature observations made in Milton during the last forty years by Mr. Charles Breck. These observations have been made twice daily from the same thermometer, hanging in the same place since the beginning of the observations in January, 1849. During the forty years, nineteen winters have been warmer than the average, and eight of the following summers have been warmer than the average. There have been eleven cases in which both the winter and spring have been warmer than the average, and following these there have been five summers warmer than the average. There have been six decidedly warm winters, that is, winters whose mean temperature was three degrees or more above the average; and four of the following summers have been warmer than the average. It is seen, then, that only about half of the warm winters were followed by warm summers; or, in other words, cool summers have followed warm winters as often as the reverse. The number of times warm summers have followed cool summers is nine, while the number of times cool summers have followed cool summers is twelve.

In the above, what has been called a warm winter is one in which the mean temperature of the three winter months — December, January, and February — has been higher than the average of forty years; and what has been called a cool summer is one in which the mean temperature of the three months of June, July, and August has been lower than the average of forty years, etc. This, however, is evidently not the definition adopted by people generally in deciding whether a winter or summer is colder or warmer than

usual, for a decided departure of the temperature of a single month in any direction may determine the impression people retain of the entire season. Thus it will surprise most people to learn that the mean temperature of last summer was slightly higher than the average of the last forty years. Both June and August were warmer than usual, and only July was very cool. It will probably be a still greater surprise to learn that the winter of 1887-88, which was generally thought to be a cold winter, was really slightly warmer than usual. December and February were both warmer than usual, and January alone was very cold. Thus people's opinion of a season seems to be largely moulded by the special character of what is usually the most extreme month of the season. If in winter January happens to be exceptionally warm or cold, the winter is decided to be of the same character; or if July happens to be decidedly warm or cool, the summer is thus characterized. It seemed, then, worth while to ascertain from Mr. Breck's record how many warm Julys followed decidedly warm Januarys. There were eight Januarys during the forty years whose average temperature was above 30°, and following these were five Julys warmer than the average of forty years; which indicates but a slight tendency for warm Julys to follow warm Januarys, since the law of chance would indicate that four warm Julys ought to follow eight warm Januarys. The number of times warm Julys have followed cool Julys is twelve; and the number of times cool Julys have followed cool Julys is eight.

Another method frequently used in predicting the weather of a coming season is based on the conclusion that during every year the average conditions remain about the same; and if the first part of the year is very warm, the latter part must be cool. This assumption, however, appears to be entirely unsupported. Mr. Breck's observations show that the mean temperature of one year may differ as much as five degrees from another. Eleven months of 1877 were observed to be warmer than usual, and nearly as great departures in the opposite direction were found in other years.

All of these facts indicate that no conclusion of any value greater than could be gained by mere guessing can be formed in regard to the character of a coming season, merely by knowing the character of a past season, until some law connecting these is worked out. This has been demonstrated over and over again in different parts of the world; but since, of course, people generally cannot keep posted in meteorological literature, there will probably continue to appear such forecasts of coming seasons, based on apparent scientific conclusions. Mr. Clayton feels sure there is a law of recurrence of meteorological phenomena besides the daily and annual periods, and also that it is not of the character usually supposed and discussed above.

NOTES AND NEWS.

IN an account of the Widdifield & Bowman Company's electric and automatic car-brake, in *Science* of May 31, p. 412, second column, 10 lines from the bottom, "in 11 seconds" should read "in 77 seconds." This company now have an office at Room 125, Temple Court, this city.

— Dr. Hellmann has published, in the *Centralblatt der Bauverwaltung*, a brief study of a cloud-burst, Aug. 2 and 3, 1888, in the Riesengebirge, in Silesia. The storm was on the west side of a storm area which was moving northward from Galicia. The rain fell from fifteen to eighteen hours, and in some parts of the Queiss valley its depth reached 200 millimetres, or 7.9 inches. Such a rainfall had not been known there before since 1804. A similar cloud-burst occurred in the region just south-east of this, in the Sudeten and Beskiden Mountains, in 1884, accompanied by a similar unusual progression of a storm area northward over Galicia and Polen.

— The governing committee of the Nineteenth Century Club of New York reports, that, notwithstanding the shadow cast over the club by the death of its founder and president, the last season has been a successful one. The meetings have been marked by a full and sometimes a crowded attendance, the membership is substantially unimpaired, and, so far as the committee can judge, the interest in the club's work remains unabated. The committee believes that nothing more is necessary than to continue on the same

lines, relaxing no effort to make the discussions as interesting as possible, but making no distinctive change in its policy. The secretary's report shows during the past half-year twelve resignations, balanced by the accession of twelve new members. There are at present seventy-one candidates upon the books. The number of gentlemen (104) is still considerably in excess of that of ladies (76). The lecture committee does not make a formal report till the fall meeting, but has reported informally that arrangements are making which will result in a very interesting and brilliant programme next winter. During the past season there has been a preponderance of political topics, owing to the fact that two discussions had to be postponed on account of sickness and death. Mr. Thomas Nelson Page will next season, however, deliver his lecture on the new Southern literature, Richard Watson Gilder of the *Century* to participate in the discussion. Mr. Bronson Howard will also deliver his address on dramatic construction, Mr. A. M. Palmer to be one of the other speakers. Hon. Seth Low has agreed to address the club on the subject, "A Metropolitan University." Three evenings are thus definitely arranged for. There may be also the postponed address from Mr. Frank J. Potter on folk-music, and Mr. George Kennan on some phases of Russian life. There are hopes of securing Sir Edwin Arnold and some other very distinguished men. A most important matter is the offer of Mr. Andrew Carnegie to furnish rooms for the club in his new Music Hall, to be erected at the corner of Seventh Avenue and 57th Street. This very generous offer will enable the club, after next season, to have permanent quarters. Meantime it is possible that in the autumn there may be other plans to consider, in addition to this one; but certainly the club will be obliged for the next winter to occupy the assembly rooms at the Opera House, though the effort will be made to get Tuesday, Thursday, or Friday evenings instead of Wednesday.

— The headquarters of the National Electric Light Association are now located at 18 Cortlandt Street, this city, to which place members are requested to send all notices of change of address or business. The secretary of the association desires to correspond with all present or prospective members manufacturing or dealing in electrical apparatus or supplies, with a view to arranging for an exhibition in connection with the summer meeting at Niagara Falls in August. Negotiations have been consummated with several railroad companies whereby visitors to that meeting will be enabled to travel at reduced rates, and similar negotiations with other companies are pending. A special limited vestibule train, for the exclusive use of delegates to the meeting, has been provided. A special car in this train will be reserved for gentlemen accompanied by ladies. In connection with the proposed exhibition, it is stated that the exhibit at the Chicago convention grew to so large proportions, and the expense was so great, that both the exhibitors and the executive committee took formal action before leaving Chicago, discouraging a large exhibit at Niagara Falls. It is found, however, that some members of the association are members for the sole purpose of making exhibits at the conventions; others have novelties brought out during the current half-year; and some insist on making an exhibit at any rate. It has been thought best, therefore, to provide for an exhibit on a moderate scale, and a number of rooms have been engaged in direct connection with the Convention Hall. Indications are that the Niagara Falls convention will be a large one. There seems to be a prevailing sentiment in favor of the attendance of the wives and lady friends of the members, and special arrangements will be made for their comfort and entertainment.

— Mr. W. H. H. Beadle writes from Chemawa, Ore., to the *American Meteorological Journal*, that as thunder is rare, and by some said not to occur in Oregon, it may be noted for record that at 11.53 A.M., standard time, April 22, peals of thunder and the characteristic rolls and reverberations were heard to the eastward from this place, which is near Salem in the Willamette valley. There was evidently a marked "low." It had rained heavily in the morning, after twenty-four hours southerly wind, and had partially cleared. The sun shone very warm, and a thunder-cloud, such as is common in Michigan summers, passed across the eastern sky from south to north.

— A rather singular personal discussion is just now going on in Vienna, over the new Court Theatre, which is very magnificent, but which has the defect that the actors cannot be heard in it. The architect is Baron von Hasenauer, one of the most distinguished architects in Europe, and the newspapers seem to have been stimulated by his conspicuous professional position to lay a good deal of blame on him for the bad acoustic quality of the building. Naturally, Baron Hasenauer does not like this; and his friends have undertaken to defend him by explaining that the plan of the structure is not due to him, but to the late Professor Semper, who prepared before his death the scheme which was carried into execution by Hasenauer. This explanation, which has probably some reason in it, far from allaying the trouble, has, as it seems, stirred up Professor Hans Semper, the son of the great architect, who demands an opportunity to demonstrate before a jury of architects that the defects of the theatre arise from errors in design and construction which do not exist in the original plans, but were introduced by Baron Hasenauer. Which of the disputants is right it is impossible to say; and, in fact, in matters of the acoustics of buildings, it is beyond the power of any person, architect or not, according to *The American Architect*, to make explanations that are of any value, beyond the most rudimentary observations, for the reason that no one knows, beyond such simple observations, any thing about the causes which make a building hard to hear in, or the remedy for such a state of affairs if it exists. Meanwhile, Baron Hasenauer's friends, including Baron Hansen and many other architects of high distinction, have shown their sympathy with him by presenting him with a eulogistic address.

— A device for secret writing by means of the type-writer is mentioned in the *Paper World* as a recent invention. It requires two type-writers similarly adjusted. They are so constructed that the types can be shifted from their normal position; so that the operator, striking the key in the usual way, really writes other letters than those in his copy, forming a cipher copy. The receiver adjusts his machine in an opposite direction, and writes from the cipher copy, and his machine records the letters of the original copy. The principle is very simple, says the *Mechanical News*, and it at once suggests the possibility of applying the principle of the combination lock to such a contrivance for all type-writers, so that each owner of a machine can set it to any combination, which only he and his correspondent should know. This must be feasible; and, if the new invention is of any use at all, its usefulness would be much increased by such a plan.

— Attention has lately been called by the *Philadelphia Press* to the peculiarly corrosive, and consequently destructive, effect of the creosote of wood-soot upon chimneys, owing to the fact that the creosote thus formed from the slow combustion of wood contains so large a proportion of pyroligneous vinegar or crude acetic acid, this acid being formed in large quantities when the combustion of wood is slow; many quarts, in fact, being condensed in cold weather where a large wood-fire is very much checked, only a few hours being required for such condensation. The acid in question dissolves lime readily, carrying it away in solution, and in this manner the mortar is frequently entirely removed from the tops of chimneys in the country, new ones suffering in the same way as the old, instances being numerous where the top courses of brick in chimneys only two years old have become entirely without support other than that afforded by the sand with which the lime was mixed.

— The annual commencement of the University of Pennsylvania — or rather its second yearly commencement, as the three medical faculties held theirs earlier in the year — shows, says *The American*, how much the old monotony of the single course in arts has been broken of late years. Graduates in science, in biology, and in finance, besides those of arts and of the law school, swelled the number to 106. The Wharton School of Finance graduated a strong class of young men deeply interested in the great public questions which are the especial subjects of instruction in this school. One of the class is Mr. Tamio Hayashi, who comes from Japan to learn political economy of the genuine American type. There are three of his countrymen in the class which graduates

next year, and others are preparing to enter. It is proposed to establish in the college faculty a course of study in which the biological sciences will hold the place of honor. In Drs. Leidy and Rothrock and their younger associates in the biological faculty, the university already possesses the means to create a strong school, and we hope the public support will be ample and encouraging.

— A new substance, singular alike in its chemical nature and in its properties, says *Nature*, has been discovered by M. Péchard. It is a mixed acid derived from oxalic and molybdic acids, and is therefore termed "oxalomolybdic acid." The crystals of oxalomolybdic acid, when dry, may be preserved unchanged either in sunshine or in the dark; but, if moist, they quickly become colored blue when exposed to the sun's rays. If characters be written on paper with the solution, they remain invisible in a weak light; but, when exposed to sunshine, they rapidly become visible, turning to a deep indigo color. It is curious that this effect only happens when the solution is spread over paper or other surfaces; for the solution itself may be kept unaltered in the bottle for any length of time, except for a trace of blue at the edge of the meniscus, where, by surface action, a little is spread against the interior glass walls. If a sheet of paper be immersed in a saturated solution of the acid, dried in the dark, and then exposed behind an ordinary photographic negative, a very sharp print in blue may be obtained by exposure to sunlight for about ten minutes. The color instantly disappears in contact with water; so that, if a piece of this sensitized paper be wholly exposed to sunlight, one may write in white upon the blue ground by using a pen dipped in water. If, however, the paper with its blue markings be exposed to a gentle heat for a few minutes, the blue changes to black, and the characters are then no longer destroyed by water.

— The Hydrographical Department of Russia has devoted since 1837, according to *Nature*, a good deal of attention to the secular rising of the coasts of the Baltic Sea, and a number of marks have been made on the rocky coasts of the Gulfs of Bothnia and Finland in order to obtain trustworthy data as to the rate of the upheaval of the coasts. Since 1869, observations have been carried on in a systematic way for measuring the changes in the level of the Baltic at several of the above-mentioned marks, and the results of the observations are now summed up by Col. Mikhailoff in the *Izvestia* of the Russian Geographical Society (vol. xxiv. 3). Taking only those stations at which the secular change could be determined for a number of years, varying from thirty-one to thirty-nine years (1839–78), the rise of the coast in a century would appear to be as follows: Aspö, 20.3 inches; Lehtë, 11.5 inches; Island of Kotkö, 26.7; Sveaborg, 22.8 and 25.1; Hangöudd, 33.7; Island of Skotland, 12.5; Island of Jussari, 31.6; Tverminö, 36.2; Island of Gloskär at Redhamn, 12.2. It thus appears that the figure of about three feet in a century, which was deduced from former observations, cannot be very far from the truth. As to local anomalies, they remain still unexplained.

— Carpenters and other tool-users who keep up with the times now use a mixture of glycerine, instead of oil, for sharpening their edge-tools. Oil, as is well known, thickens, and smears the stone. The glycerine may be mixed with spirits in greater or less proportion, according as the tools to be sharpened are fine or coarse. For the average blade, two parts of glycerine to one of spirits will suffice.

— The Elizabeth Thompson Science Fund, which has been established by Mrs. Elizabeth Thompson of Stamford, Conn., "for the advancement and prosecution of scientific research in its broadest sense," now amounts to twenty-five thousand dollars. As accumulated income is again available, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the fol-

lowing points: 1. Precise amount required; 2. Exact nature of the investigation proposed; 3. Conditions under which the research is to be prosecuted; 4. Manner in which the appropriation asked for is to be expended. All applications should be forwarded to the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A. It is intended to make new grants at the end of 1889. The trustees are disinclined, for the present, to make any grant exceeding five hundred dollars: preference will be given to applications for smaller amounts. The following is the list of grants made: \$200 to the New England Meteorological Society, for the investigation of cyclonic movements in New England; \$150 to Samuel Rideal, Esq., of University College, London, England, for investigations on the absorption of heat by odorous gases; \$75 to H. M. Howe, Esq., of Boston, Mass., for the investigation of fusible slags of copper and lead smelting; \$500 to Professor J. Rosenthal of Erlangen, Germany, for investigations on animal heat in health and disease; \$50 to Joseph Jastrow, Esq., of the Johns Hopkins University, Baltimore, Md., for investigations on the laws of psycho-physics; \$200 to the Natural History Society of Montreal, for the investigation of underground temperatures; \$210 to Messrs. T. Elster and H. Geitel of Wolfenbüttel, Germany, for researches on the electrization of gases by glowing bodies; \$500 to Professor E. D. Cope of Philadelphia, Penn., to assist in the preparation of his monograph on American fossil vertebrates; \$125 to E. E. Prince, Esq., of St. Andrews, Scotland, for researches on the development and morphology of the limbs of teleosts; \$250 to Herbert Tomlinson, Esq., of University College, England, for researches on the effects of stress and strain on the physical properties of matter; \$200 to Professor Luigi Palmieri of Naples, Italy, for the construction of an apparatus to be used in researches on atmospheric electricity; \$200 to William H. Edwards, Esq., of Coalburg, W.Va., to assist the publication of his work on the butterflies of North America; \$150 to the New England Meteorological Society, for the investigation of cyclonic phenomena in New England; \$25 to Professor A. F. Marion, for researches on the fauna of brackish waters; \$300 to Professor Carl Ludwig, for researches on muscular contraction, to be carried on under his direction by Dr. Paul Starke; \$200 to Dr. Paul C. Freer, for the investigation of the chemical constitution of graphitic acid; \$300 to Dr. G. Müller, for experiments on the resorption of light by the earth's atmosphere; \$300 to Professor Gerhard Krüss, for the investigation of the elementary constitution of erbium and didymium; \$50 to Dr. F. L. Hoorweg, for the investigation of the manner and velocity with which magnetism is propagated along an iron bar; \$150 to Mr. William H. Edwards, to assist the publication of his work on North American butterflies.

— Charles A. Ashburner, the well-known Pittsburgh geologist, had the honorary degree of doctor of science conferred upon him at the commencement of the University of Pennsylvania, June 7, as an acknowledgment of the high scientific value and merit of his surveys and reports for the Geological Survey of Pennsylvania. Dr. Ashburner was graduated from the University of Pennsylvania about fifteen years ago with the highest rank in his class, and immediately entered the corps of the United States Lighthouse Service Survey. Upon the organization of the Pennsylvania Geological Survey, he resigned from the government work, and was appointed assistant of Professor Lesley, State geologist, with whom he has been associated ever since. About two years ago he gave up much of his active State work, and went to Pittsburgh to assume connection with Mr. Westinghouse in his extensive mining interests, particularly in the mining of natural gas; latterly, however, making extensive geological and mining examinations in the Rocky Mountains and on the Pacific slope.

— MM. Mannesmann of Remscheid, Westphalia, are manufacturing fly-wheels capable of double and even treble the speed of fly-wheels made of cast-iron, the resistance of which is generally limited to a speed of forty metres per second for the rim of the wheel. They have succeeded in obtaining fly-wheels which are capable of acquiring three times the speed of ordinary fly-wheels by constructing the nave and the spokes of iron or steel, and making a rim entirely of steel wire wound round and round itself a great many times.

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SOME TIME SINCE, WE REFERRED to the appointment of a commission by the New York City Board of Health for the purpose of formulating a concise statement regarding the contagiousness of tuberculosis and the means of protection therefrom. This commission was formed of Drs. Prudden, Biggs, and Loomis, pathologists to the Board of Health, and in this number we publish their report. In this report the position is taken that consumption is not necessarily an hereditary disease, and that in certain stages its cure is possible. If this dread disease may now be ranked among preventable evils, it is desirable that this should be widely known, and that the means by which this result may be reached may be understood by the public at large. To aid a free discussion of the questions at issue, we print on one of our advertising pages a few questions to which we should be pleased to receive answers.

THE REPORT of the superintendent of health of Providence, a full abstract of which we give in this number, contains many items of interest. The most important of these is the statement that typhoid-fever germs were found in three of the filters in use in that city, in houses where typhoid-fever existed. In this report Dr. Chapin states that the house-filters in common use collect filth and microbes from the water, and act as incubators for the latter. There is no doubt, that, when first put into use, a filter may be of

advantage so far as sifting out the grosser particles of suspended matter; but it soon becomes itself filthy, and the constantly accumulating filth furnishes the most favorable nidus for the growth of disease-germs.

THE CELEBRATION OF THE CENTENNIAL of the discovery of oxygen at Priestley's grave at Northumberland, Penn., in 1874, by a gathering of distinguished American chemists, was the occasion for the suggestion of the formation of an American chemical society, with headquarters in New York. This suggestion was due principally to H. Carrington Bolton; but nothing resulted until 1876, when the American Chemical Society was started, with J. W. Draper as president. After him Dr. J. Lawrence Smith, Professor C. H. Chandler, and Dr. James C. Booth filled the presidential chair. The meetings flourished for a time; but, after a little, the more prominent New York members failed to appear with any regularity, and the management of the society fell into the hands of the lesser members, with the result of a languishing condition of affairs ever since. Some two or three years ago the matter was brought up at a meeting of the American Association, and the formation of a national chemical society, with headquarters at Washington, was advocated. This did not, however, meet the views of all; and a proposal is now made that the American Chemical Society shall be resuscitated, and that the meetings shall be held in conjunction with the meetings of the American Association for the advancement of Science. A committee has been appointed to consider this matter at the Toronto meeting, and delegates from the American Chemical Society and from the chemical section of the Franklin Institute have been appointed.

CLARK UNIVERSITY.

CLARK UNIVERSITY was founded by the munificence of a native of Worcester County, whose plans, conceived more than twenty years ago, have gradually grown with his fortune. His affairs have been so arranged as to allow long intervals for travel and study. During eight years thus spent, the leading foreign institutions of learning, old and new, were visited, and their records gathered and read. These studies centred about the means by which the highest culture of one generation is best transmitted to the ablest youths of the next, and especially about the external conditions most favorable for increasing the sum of human knowledge. To the improvement of these means and the enlargement of these conditions, the new university will be devoted.

It is the strong and express desire of the founder that the highest possible academic standards be here forever maintained; that special opportunities and inducements be offered to research; that to this end the instructors be not overburdened with teaching or examinations; that all available experience, both of older countries and our own, be freely utilized; and that new measures, and even innovations, if really helpful to the highest needs of modern science and culture, be no less freely adopted; in fine, that the great opportunities of a new foundation in this land and age be diligently explored and improved.

He has chosen Worcester as the seat of the new foundation after mature deliberation, first, because its location is central among the best colleges of the East, and, by supplementing rather than duplicating their work, he hopes to advance all their interests, and to secure their good will and active support, that together further steps may be taken in the development of superior education in New England; and, second, because he believes the culture of this city will insure that enlightened public opinion indispensable in maintaining these educational standards at their highest, and that its wealth will insure the perpetual increase of revenue required by the rapid progress of science.

As the first positive step towards the realization of these long-formed plans, Mr. Clark invited the following gentlemen to constitute with himself a board of trustees: Stephen Salisbury, Charles Devens, George F. Hoar, William W. Rice, Joseph Sargent,¹ John D. Washburn, Frank P. Goulding, and George Swan.

¹ Died Oct. 12, 1888.

A charter was granted early in 1887. Land and other property that had been before secured by the founder was transferred to the board, and the erection of a central building was begun.

In the spring of 1888, G. Stanley Hall, then a professor at the Johns Hopkins University, was invited to the presidency. The official letter conveying this invitation contained the following well-considered and significant expression of the spirit animating the trustees: "They desire to impose on you no trammels; they have no friends for whom they wish to provide at the expense of the interests of the institution, no pet theories to press upon you in derogation of your judgment, no sectarian tests to apply, no guaranties to require, save such as are implied by your acceptance of this trust. Their single desire is to fit men for the highest duties of life, and, to that end, that this institution, in whatever branches of sound learning it may find itself engaged, may be a leader and a light."

The president was at once granted one year's leave of absence, with full salary, to visit universities in Europe. This year was diligently improved, and a report of its work will be made later.

The plans of the university have now so far progressed that work will begin in October next, in mathematics, physics, chemistry, biology, and psychology. These departments are provisionally arranged below in the order, not of prominence or completeness with which they will be organized at the opening, but only in the order of fulness with which announcements are now ready.

The president of the university has been appointed temporary professor of psychology, and will continue, so far as other engagements will permit, to direct the work of this department as formerly at the Johns Hopkins University. By instruction or seminars, or by careful personal conference and guidance to the best literature, and with the aid of Dr. Sanford, attention will be directed to the following topics: the general properties of the nervous substances; the psycho-physiology of each of the special senses and their defects; the perception of time and space; the time-sense; the psycho-physic law; mental images (morbid and normal) and their associations; the leading topics in the psychology of insanity, especially aphasia, illusions and hallucinations, melancholia, neurasthenia, epilepsy, hysteria, mania, and paralysis; instinct; the psychology of language; myth, custom, and belief anthropologically considered; hypnotism, and the psychological side of the history of philosophy, especially the Greek, German, and English systems. Dr. Hall will also direct the work of a few students of Class III. (below) in the history, methods, and organization of education, elementary, intermediate, and superior. On these topics he will give a special course of lectures during a part of the year.

Opportunities in psychology will be supplemented by work in the biological department, and especially by that of Dr. Donaldson. A well-equipped laboratory of apparatus for research in the various departments of experimental psychology will also be opened in October.

Opportunities for prompt publication of meritorious investigations, together with digests of current literature in this department, will be found in *The American Journal of Psychology*, which is published under the editorial care of Dr. Hall.

Henry H. Donaldson has been appointed assistant professor of neurology. Dr. Donaldson was graduated from Yale College in 1879. After spending a year at the Sheffield Scientific School and another at the College of Physicians and Surgeons in New York City, he was appointed a fellow of Johns Hopkins University for two years, receiving the degree of doctor of philosophy there in 1885. A year and a half was then spent in Europe, chiefly with Professors Gudden at Munich, Forel at Zurich, and Golgi at Turin, and on returning he was appointed associate in psychology in the Johns Hopkins University.

Dr. Donaldson will give instruction in the finer anatomy of the central nervous system in man, in the histology of the sense-organs in the vertebrate series, and the localization of function in the brain, together with such other topics as may serve to facilitate study in these lines.

Those desiring further information concerning leading works of reference, or the equipment of the laboratory, can address Dr. Donaldson during the summer at Worcester.

Edmund Clark Sanford, who has been appointed instructor in psy-

chology, was graduated from the University of California in 1883. He has since spent four years at the Johns Hopkins University, where he was appointed fellow in psychology in 1887, and received the degree of doctor of philosophy the following year. The past academic year has been spent as instructor in the undergraduate department of the Johns Hopkins University, and in editing, under Dr. Hall's supervision, *The American Journal of Psychology*.

Dr. Sanford will give the two following special courses: First half-year, the physiological psychology of vision; monocular vision, color-perception, contrast, etc.; binocular vision, stereoscopy, and the horopter; perception of space, nativism, and empiricism. Chief authorities, Helmholtz, Hering, Wundt. The aim will be to demonstrate all the important experiments mentioned in the course, with suitable apparatus. Second half-year, the application of time-measurements to psychology, simple and complicated re-action times, personal equation, association times, and time-sense.

Dr. Sanford will also assist Professor Hall in the work of instruction and in the direction of the psycho-physic laboratory, seminary, etc. It is hoped that fuller opportunities for the study of historical philosophy, logic, and ethics may eventually be offered.

The work of the psychological department is intended for the following classes of students: those who desire to teach philosophy in any or all of its departments; physicians or medical students who wish to become specialists in the treatment of insanity or of diseases with nervous complications; those who desire to study education professionally, and who are advised to give most of their energy to psychology, which is its chief scientific basis, pedagogy being a field of applied psychology.

Some of the special topics into which the work above naturally falls can be attended as a special course by students of other departments. Thus students of biology or pathology may follow the histological course of Dr. Donaldson; students of classics may follow the course in Greek philosophy; of morphology, the lectures on instinct; of astronomy, the lectures on re-action time and the personal equation.

In the department of biology, Warren P. Lombard was appointed assistant professor of physiology in August, 1888. Dr. Lombard was graduated from Harvard College in 1878, and from Harvard Medical School in 1881. In 1881-82 he was prosector and lecturer in the College of Physicians and Surgeons in New York City, and for the next three years, 1882-85, attended lectures and was engaged in research work in Germany, chiefly in the laboratory of Professor Ludwig in Leipzig. The next three years were devoted to research and to the duties of lecturer and assistant in physiology at the College of Physicians and Surgeons, and elsewhere. The present year is being spent in the laboratories of Professors Dastre and Darsonval of Paris, Professor Mosso of Turin, and elsewhere. Work in this department will be conducted with the aid of lectures, laboratory, conferences, etc., and will cover the physiology of digestion, secretion, respiration, circulation, the nerves, muscles, and senses. The laboratory will be well furnished with instruments and other appliances for investigation in each of these special fields.

F. Mall has been appointed adjunct professor of anatomy. Dr. Mall was graduated from the University of Michigan in 1883, where he received the degree of M.D. He studied one year with Professor Kuhne at Heidelberg, and two years with Professors Weigert, His, and Ludwig in the University of Leipzig. Since 1886 he has been successively fellow, instructor, and associate in pathology, in the Johns Hopkins University. Dr. Mall will offer two courses, — one in histology, and one in vertebrate embryology.

Albert A. Michelson has been appointed acting professor of physics. Dr. Michelson was graduated at the United States Naval Academy in 1873, where he afterwards served as instructor in physics and chemistry for four years. He was later attached to the Nautical Almanac Office in Washington. For two years, beginning in 1880, he worked in Europe under Helmholtz, Quincke, Mascart, and Cornu. On returning, he resigned his commission of master (now called lieutenant) in the navy, and became professor of physics in the Case School of Science, Cleveland, O., where he has since remained. In 1888 he was awarded the Rumford medals for his researches on the velocity of light. Dr. Michelson

is a member of the American Academy of Science, corresponding member of the British Association, vice-president of the American Association for the Advancement of Science, etc.

Professor Michelson will give a course of illustrated and experimental lectures in physics, extending through two years. These will treat the chief topics in this department, and will be sufficiently advanced for students intending to make physics a specialty, and will be interspersed by examinations and conferences. This course will be supplemented by a series of lectures or readings in theoretical optics, electricity, and magnetism, or in thermodynamics of a more informal nature. Students with a fair knowledge of integral and differential calculus will have no difficulty in following this course.

A graded course of laboratory instruction will be offered for practical acquaintance with special methods. Dr. Michelson will strive, by advice and example, to encourage a spirit of diligent investigation and original research, particularly in those intending to find their life-work in this department.

The organization of no department will probably be more complete in October than that of chemistry. A large laboratory of about fifty rooms will be ready for occupation, and the names of some of the instructors can be very soon announced. Appliances for the department of mathematics are also liberally ordered. The names of instructors will soon be announced.

The organization of all the above and other departments will be gradual, and the foundation period of the university will cover some years. Apparatus is being extensively ordered of the best makers in this country and in Europe, chiefly from those who devote themselves to the special class of apparatus in which they excel.

Besides field-work, excursions to institutions public and private, coaching and cram classes, examinations, conferences, and other modes by which knowledge now seems best imparted and retained, the following educational methods will probably be prominent:—

Seminaries.—These are stated, perhaps weekly, meetings, often in a department library, for joint, systematic, but conversational work, under the personal direction of the professor, in some special chapter of his subject. Here the results of individual reading are reported for the benefit of all; views are freely criticised; new inquiries, methods, comparisons, standpoints, etc., suggested. From the mutual stimulus thus given, many important works have proceeded; and the efficiency of universities, especially in Germany, where seminars were first generally introduced, has been greatly increased.

Laboratory Work.—For beginners, this was from the first the best of all forms of apprenticeship, bringing student and professor to a far closer and mutually stimulating relation. Here the manipulation of apparatus is learned, each well-chosen piece of which is an obvious epitome of long lines of research, processes are criticised, results obtained by other investigators are tested, methods are discussed and perfected. The modern laboratory has thus become an unexcelled school of logical mental discipline, from which is developed, as its best product, that rare independence in research which is the consummation of scientific culture.

Lectures.—The trustees desire that each instructor, of however few students, should prepare and deliver regular lectures, with diagrams, illustrative apparatus, and references to standard text-books and the best current literature upon each topic. Advanced students and instructors will also be encouraged to supplement the work of the professors by giving special lectures and courses. Public lectures will from time to time be given.

The following classes of students will be admitted:—

I. *Independent Students.*—This class will include those who have already taken the doctorate or other academic degrees in this country or abroad, and others of sufficient training who have time that may be devoted to particular lines of study or research. For competent men of this class, individual arrangements may be made and an independent room, and even special apparatus and books, provided, that they may pursue their investigations, either alone or with the aid and counsel of the instructors, to the best advantage. Conditions under which a few of the most advanced students of this class can be granted the *venia docendi*, as lecturers or docents, are under careful consideration. It is hoped that some of the per-

manent instructors of the university may be recruited from this class. It is probable that a few of these mature students can be received, not only in the five departments named above, but in others soon to be organized, and in the development of which they may co-operate.

II. *Candidates for the Degree of Doctor of Philosophy.*—Those qualifying for this degree will be matriculated early in the fall, after suitable tests, which will also aid in determining when they can be admitted to the final examination. The full course provided for this class of students will be three years, but admission to advanced standing at the outset is possible; and those found to be qualified may be allowed to take the doctor's examination in two years, or even one. It is to the needs of these students that the lectures, seminars, laboratories, and collections of books and apparatus will be especially shaped, and no pains will be spared to afford them every needed stimulus and opportunity. It is for them that the fellowships and scholarships are primarily intended, although any of these honors may be awarded to students in Classes I. or III.

III. *Special Students not Candidates for a Degree.*—This class includes those who may desire to devote themselves exclusively to one or more of the special branches, — mathematics, physics, chemistry, biology, or psychology, — but who do not care to matriculate, or become candidates for a degree. These students, provided they satisfy the heads of departments of their training and competency in one subject, in which they must be advanced (although they may be less so, or even beginners, in other subjects), may be allowed entire freedom in their choice and combination of studies, and, as special students, may enjoy all the privileges of the university.

IV. *Medical Students.*—The university offers special facilities in those fundamental disciplines upon which the study of medicine in all its departments now rests. Thus, students of sufficient preliminary training can be admitted in the departments of chemistry, biology, anatomy, physiology, and neurology, and receive here the purely scientific part of a medical education.

V. *Preliminary Candidates or Undergraduates.*—Non-university students of less special or less advanced standing than the above four classes, who are nearly but not quite qualified to become candidates for the degree of doctor of philosophy, may also be received. Students of this class must for the present have completed the work of the first three, or at least of the first two, years of a regular undergraduate course in a college of good standing, or the equivalent thereof. They must satisfy the authorities of the university that they can proceed to the degree of A.B. in one year, and contemplate advancing to a higher degree. The privileges and status of these students will be more fully defined later. They may be elected to scholarships, but not to fellowships.

To no form of educational gift or bequest have probably so many people contributed as to the various forms of individual aid to meritorious students. Under the names of bursaries, stipends, exhibitions, prizes, benefices, etc., as well as of scholarships and fellowships, the revenues of foundations established by and bearing the names of sometimes hundreds of donors in a single university, are annually distributed.

Sometimes these funds were given by men or women themselves not far removed from need, and are appointed to furnish a student with firewood, a room, a bed, one daily meal, or a coat each year, etc., and sometimes yielding one or two thousand dollars to a single holder. Often many students were provided by a single donor, and some of these European foundations, even the smallest, are centuries old, so sacredly are they guarded, and others are even now being established. The more advanced the education, the more such aids are needed, and the more numerous and substantial do they in fact become in Europe.

So great is now the need of bringing the best intellects to fullest maturity, and so increasingly necessary for the highest scientific attainment are now the leisure, tranquillity, books, and apparatus thus best supplied, that the demand is strong for still more and greater aids of this kind for advanced and competent students.

Several of the wisest governments in Europe, recognizing that the modern world and its rulers are ruled by experts thus best trained, vie with private munificence in supplying such aids. With a deep sense of the peculiar needs of our country in this respect,

the founder of this university, and his wife, have provided such opportunity and incentive here as follows:—

In addition to all previous gifts of the donor, and apart from the permanent funds of the university, full tuition of two hundred dollars each for thirty meritorious students will be paid into the treasury. For eight of these students, thus freed from tuition, Mr. Clark has also established fellowships yielding each holder four hundred dollars per annum, and eight more fellowships yielding each holder two hundred dollars per annum. These, with eight free scholarships as above provided, will be known as the "Jonas G. Clark Scholarships and Fellowships" respectively. Mrs. Clark has established two fellowships yielding four hundred dollars each, and two fellowships yielding two hundred dollars each, per annum. These, with the two remaining scholarships, will be known as the "Mrs. Jonas G. Clark Fellowships and Scholarships" respectively. These six latter are especially provided for the department of psychology, while the twenty-four presented by Mr. Clark are to be distributed among the other four departments at the discretion of the president and faculty.

The founder and his wife unite with the trustees and president in inviting sympathy and practical co-operation in the multiplication of such aids, large or small, temporary or permanent, here at the outset. Both scholarships and fellowships are open only to students in one or more of the five departments announced, and are renewable annually. They are designed to encourage promising young men, graduates of colleges and others, who have developed a preference for particular lines of study in which they desire to attain still further proficiency.

While intended to remove pecuniary hinderances in the way of such students, both scholarships and fellowships are primarily honors, awarded without reference to pecuniary needs. Thus, those desiring to do so may relinquish the emolument, and retain the title of scholar and fellow.

A plain, substantial, and well-appointed central building, 204 by 114 feet, four stories high, and with superior facilities for heating, lighting, and ventilation, has been constructed of brick and granite, and finished throughout in oak. A chemical laboratory, designed after consulting many experts and plans of recent European buildings, and containing about fifty rooms, is nearly completed. The foundations of a still larger department building are laid.

The work of instruction will begin in the five departments above announced, on Wednesday, Oct. 2, 1889.

TO PREVENT CONSUMPTION.

DRS. PRUDDEN, BIGGS, AND LOOMIS, pathologists to the Board of Health of the city of New York, having been requested to formulate a brief and comprehensive statement regarding the contagiousness of tuberculosis and the means of protection therefrom, have submitted the following:—

The disease known as tuberculosis, and, when affecting the lungs, as pulmonary tuberculosis (consumption), is very common in the human being, and in certain of the domestic animals, especially cattle. About one-fourth of all deaths occurring in the human being during adult life are caused by it, and nearly one-half of the entire population at some time in life acquires it. The disease is the same in nature in animals and in man, and has the same cause.

It has been proved beyond a doubt that a living germ, called the "tubercle bacillus," is the cause, and the only cause, of tuberculosis. It does not seem necessary to state the facts upon which this assertion is based, for the observation first made by Robert Koch in 1882 has been confirmed so often and so completely that it now constitutes one of the most absolutely demonstrated facts in medicine.

Tuberculosis may affect any organ of the body, but most frequently first involves the lungs. When the living germs find their way into the body, they multiply there, if favorable conditions for their growth exist, and produce small new growths or nodules (tubercles), which tend to soften. The discharges from these softened tubercles, containing the living germs, are thrown off from the body. In pulmonary tuberculosis these discharges constitute, in part, the expectoration. The germs thus thrown off

do not grow outside the living human or animal body, except under artificial conditions, although they may retain their vitality and virulence for long periods of time, even when thoroughly dried. As tuberculosis can only result from the action of these germs, it follows, from what has just been said, that, when the disease is acquired, it must result from receiving into the body the living germs that have come from some other human being or animal affected with the disease.

It has been abundantly established that the disease may be transmitted by meat or milk from the tubercular animal. The milk-glands in milch cows often become affected with the disease when their lungs are involved, and the milk from such animals may contain the living germs, and is capable of producing the disease. Among stall-fed dairy cows, 20 per cent or 30 per cent are sometimes found to be affected with the disease. Tubercular animals are also frequently killed for food, their flesh sometimes containing the germs, and, if not thoroughly cooked, it is capable of transmitting the disease. Boiling the milk, or thoroughly cooking the meat, destroys the germs. Although the meat and milk from tubercular animals constitute actual and important sources of danger, the disease is acquired, as a rule, through its communication from man to man.

Tuberculosis is commonly produced in the lungs (which are the organs most frequently affected) by breathing air in which the living germs are suspended as dust. The material which is coughed up, sometimes in large quantities, by persons suffering from consumption, contains these germs, often in enormous numbers. This material, when expectorated, frequently lodges in places where it afterward dries, as on the streets, floors, carpets, clothing, handkerchiefs, etc. After drying, in one way or another, it is very apt to become pulverized, and float in the air as dust.

It has been shown experimentally that dust collected from the most varied points in hospital wards, asylums, prisons, private houses, etc., where consumptive patients are present, is capable of producing tuberculosis in animals when used for their inoculation. Such dust may retain for weeks its power of producing the disease. On the other hand, dust collected from rooms in institutions or houses that have not been occupied by tubercular patients does not produce the disease when used for the inoculation of animals.

These observations show, that, where there are cases of pulmonary tuberculosis, under ordinary conditions the dust surrounding them often contains the "tubercle bacilli," and persons inhaling the air in which this dust is suspended may be taking in the living germs. It should, however, be distinctly understood that the breath of tubercular patients, and the moist sputum, received in proper cups, are not elements of danger, but only the dried and pulverized sputum. The breath and moist sputum are free from danger, because the germs are not dislodged from moist surfaces by currents of air. If all discharges were destroyed at the time of exit from the body, the greatest danger of communication from man to man would be removed.

It then follows, from what has been said, that tuberculosis is a distinctly preventable disease. It is a well-known fact that some persons, and especially the members of certain families, are particularly liable to tuberculosis; and this liability can be transmitted from parents to children. So marked and so frequent is this liability, and so frequent is the development of the disease in particular families, that the affection has long been considered hereditary. We now know that tuberculosis can only be caused by the entrance of the germ into the body, and that this transmitted liability simply renders the individual a more easy prey to the living germs when once they have gained entrance.

The frequent occurrence of several cases of pulmonary tuberculosis in a family is, then, to be explained, not on the supposition that the disease itself has been inherited, but that it has been produced after birth by transmission directly from some affected individual. Where the parents are affected with tuberculosis, the children, from the earliest moments of life, are exposed to the disease under the most favorable conditions for its transmission; for not only is the dust of the house likely to contain the bacilli, but the relationship also between parents and children, especially between the mother and child, is of that close and intimate nature especially favorable for the transmission by direct contact.

If, then, tuberculosis is not inherited, the question of prevention resolves itself principally into the avoidance of tubercular meat and milk and the destruction of the discharges, especially the sputum of tubercular individuals. As to the first means of communication, those measures of prevention alone answer the requirements which embrace the governmental inspection of dairy cows and of animals slaughtered for food, and the rigid exclusion and destruction of all those found to be tubercular.

For the removal of the second means of communication, i.e., the sputum of tubercular individuals, the problem is simple when the patients are confined to their rooms or houses. Then, wooden or pasteboard cups, with covers, should always be at hand for the reception of the sputum. These cups are supported in simple racks, and at least once daily, or more frequently if necessary, should be removed from the racks and thrown with their contents into the fire. A cheap and efficient cup answering this purpose is now on the market, and is supplied by the druggists.

The disposition of the expectoration of persons who are not confined to their rooms or homes is a far more difficult problem. The expectoration certainly should not be discharged on the street, and the only practicable means for its collection seems to be in handkerchiefs, which, when soiled, should at the earliest possible moment be soaked in a solution of five per cent carbolic acid, and then boiled and washed. Handkerchiefs thus soiled are exceedingly dangerous factors in distributing tubercle bacilli; for, when the sputum becomes dry, it is easily separated in flakes from the cloth, and then soon becomes pulverized and suspended as dust.

It becomes evident from what has been said that the means which will most certainly prevent the spread of this disease from one individual to another are those of scrupulous cleanliness regarding the sputum. These means lie largely within the power of the affected individual. It is furthermore to be remembered that consumption is not always, as was formerly supposed, a fatal disease, but that it is in very many cases a distinctly curable affection.

An individual who is well on the road to recovery may, if he does not with the greatest care destroy his sputum, diminish greatly his chances of recovery by self-inoculation.

While the greatest danger of the spread of this disease from the sick to the well is in private houses and in hospitals, yet, if this danger is thoroughly appreciated, it is, for the most part, quite under control through the immediate destruction of the sputum and the enforcement of habits of cleanliness. But in places of public assembly, such as churches and theatres, particularly the latter, conditions are different, and the safety would seem to depend largely upon a dilution and partial removal of the floating and possibly dangerous dust by means of adequate ventilation.

Rooms in private houses and hospital wards that are occupied by phthisical patients should from time to time be thoroughly cleaned and disinfected, and this should always be done after they are vacated before they are again occupied by other individuals. Steamship companies should be obliged to furnish separate apartments for consumptive persons, so that no person in the exigencies of travel need be forced to share his room with one who might be a source of active danger to him.

Drs. Prudden, Biggs, and Loomis desire especially to emphasize the following facts: (1) that tuberculosis is a distinctly preventable disease; (2) that it is not directly inherited; and (3) that it is acquired by the direct transmission of the tubercle bacilli from the sick to the healthy, usually by means of the dried and pulverized sputum floating as dust in the air.

The measures, then, which are suggested for the prevention of the spread of tuberculosis are (1) the security of the public against tubercular meat and milk, attained by a system of rigid official inspection of cattle; (2) the dissemination among the people of the knowledge that every tubercular person may be a source of actual danger to his associates if the discharges from the lungs are not immediately destroyed or rendered harmless; and (3) the careful disinfection of rooms and hospital wards that are occupied or have been occupied by phthisical patients.

THE annual meeting of the American Climatological Society will be held in Boston, June 24 and 25; Dr. V. L. Bowditch of Boston, president.

SIXTH ANNUAL REPORT OF THE SUPERINTENDENT OF HEALTH OF PROVIDENCE.

IN this report, Dr. Charles V. Chapin, the superintendent of health, records many important facts and observations. The number of deaths reported was 2,608. The population of the city being 121,500, this gives a death-rate of 21.48 per thousand. From consumption there were 359 deaths, an increase of 46 over 1887: 10.39 per cent of all deaths were from diarrhoeal diseases. Malarial fever first appeared in Providence in 1880, when one death was reported from that cause. Since that time 92 deaths have occurred from that cause: 9 in 1885, 11 in 1886, 28 in 1887, and 44 in 1888. The disease is confined almost entirely to certain well-defined districts of the city, which are particularly exposed to those influences which have been conclusively shown to be the chief causes of the production of the malarial poison. But 2 deaths occurred from measles, while there were 28 from whooping-cough. There were no deaths from small-pox: indeed, there has been but one death from that disease in Providence since 1875.

Dr. Chapin, in this report, deals specially with two forms of contagious disease, — scarlet-fever and typhoid-fever, — and it is to these two subjects that we shall mainly devote our attention. In writing of scarlet-fever, he says, "Scarlet-fever is one of those contagious diseases which tend to recur in epidemics at more or less regular intervals. Since 1840 there have been ten epidemic periods, separated by intervals of about five years. As is usual with the disease in this part of the world, these epidemics generally have begun in the autumn, and increased in severity until late in the winter or spring. One of these epidemics, though not a severe one either as regards the number of cases or the mortality, began in August, 1884, attained its maximum in November, and was pretty well over by early spring. In 1887 another epidemic occurred, beginning in August.

"During the epidemic of 1884, some efforts were made by this department, chiefly by regulating school-attendance, to check its spread, but apparently without any very great influence. The rapid onset of the disease in the autumn of 1887 so attracted the attention of the public, that it was deemed feasible to adopt more stringent measures. While it cannot be definitely proved that the marked falling-off in the cases and deaths from this disease which immediately followed the adoption of more stringent measures was due to this, yet it is rendered highly probable from the fact that such a decrease in scarlet-fever at that time of the year is markedly at variance with the usual course of the disease in Providence, and indeed in all cities in this climate. Though there is no theoretical reason why scarlet-fever, being a purely parasitic disease, should not be entirely stamped out, yet we can never hope to accomplish this, so long as the public, and physicians also, are as careless about it as they are at the present day. While in the majority of cases, except among the very poor pretty fair isolation is maintained at first, it is not kept up long enough, and children are often allowed to ride in the horse-cars, go to Sunday-school, or visit a clothing store and try on half a dozen different coats, by the end of the third week, and before they have ceased to peel; and the most discouraging thing about it is, that it is often done with the consent of the attending physician. It must, I am afraid, be the duty of the health department to insist upon the contagious nature of this disease for many years to come, and, while striving not to render its rules inoperative by reason of their being too far in advance of public sentiment, strive, whenever opportunity offers, to make them more and more stringent.

"It is popularly believed that nearly every person will have scarlet-fever sooner or later; and I very frequently see persons who say they had rather let their children catch scarlet-fever while they are young, as it would go so much harder with them when they grow up. But such a belief is totally without foundation. During the past five years there were reported about 2,300 cases of scarlet-fever. If we assume that this rate has been continuous for the last fifteen years, then there have been only a little over 7,000 cases of scarlet-fever during that time. If we approach the problem in another way, and take the deaths during the last fifteen years, and assume the mortality to have been ten per cent, which is certainly low, the number of cases during this time is 13,970, or, in

round numbers, 14,000. The total number of children in the city under fifteen years, at the census of 1885, was 34,592: it must now be at least 36,000. Therefore, if we assume that the general death-rate of those who have had scarlet-fever is the same as those who have not, and the same relative figures are true for those who have moved into the city, there must, by the most unfavorable estimate, be one and one-half persons of fifteen years of age living in Providence who have not had scarlet-fever to every one that has. Or if we take the more favorable estimate, which I think is nearer the truth, there are at present four persons of that age who have not had scarlet-fever to every one that has. The age of fifteen is selected because scarlet-fever is rare after that; for, out of nearly a thousand cases in this city, there were only twenty-four over fifteen. The chance, then, of a child's growing up without having scarlet-fever, is even now very good. It can be made still better by a proper observance of sanitary rules. In four cases where children who had been removed at the inception of the disease were taken sick on their return, they were absent from four to five weeks, and were attacked within two or three days after their return. In the other cases the absence continued for from four to six weeks in the majority, but was less than that in some instances, and greater in others. We may, I think, fairly infer from them, that, when a child is exposed to scarlet-fever in its own family, its chances of escaping or contracting the disease are about even. The figures also show that when not brought in such intimate contact, but when merely a resident of the same house but in another tenement, the chance of contracting the disease is much less, being in fact one in seven. The recognition of this fact has made me somewhat more lenient than formerly in excluding children from school. In houses where I am satisfied that there is no direct communication between the families, I only exclude those children in the family in which disease actually exists, allowing the other children in the house to continue their attendance. Of course, where there is any doubt about the children mingling, as there always is in the crowded tenements of the poorer classes, it is necessary to exclude all in the house.

"In regard to fumigation, it is seen, that, in the 114 cases where fumigation with sulphur was done as well as it could be in a private house, the disease extended beyond the family where it first appeared, to others in the house, ten times. This is less often than when fumigation was not done, the ratio then being about one to four, and in the latter case one to eleven. But how much credit is to be given to the fumigation for this, I do not know. When people attend to fumigation properly, they usually are careful about isolation also, and the disinfection of soiled linen, etc., and they are also more thorough in the application of inunction; and it is probable that all these things have as much or more to do with the restriction of the disease than does the final fumigation."

Dr. Chapin speaks doubtfully of inunction of the skin as a preventive of the spread of scarlet-fever. In cases where it was practised, out of 714 susceptible children in families where the disease existed, 467 were attacked, which is a larger proportion than where it was not done. This method was proposed by Dr. Jamieson, and has given good results in Great Britain. Its failure in Providence may be due to its improper performance, or the neglect of parents to continue it long enough.

The number of deaths from typhoid-fever during the first eleven months of 1888, while in excess of the preceding year, was not much above the average for the past few years. The autumn was warm and rainy, and it was thought that the slight increase in this disease might be due to these meteorological conditions. During the last week in November, however, the disease increased greatly and suddenly, and almost as suddenly diminished during the early part of December. During the two weeks ending Dec. 15, 223 cases of typhoid-fever were reported at the superintendent's office, 139 being reported during the week ending Dec. 8. This is the largest number ever reported in one week, except during the epidemic of 1882, when 163 cases were reported during the week ending Nov. 11. The number of deaths in December from typhoid-fever was 47, which has been exceeded only once, by 70 deaths in November, 1882. The next largest number of deaths was 32, in April, 1883. It will thus be seen that the epidemic, though short, was severe.

For this outbreak there must have been some peculiar and local exciting cause. General meteorological conditions must be excluded, for they would have operated over the neighboring country as well as in Providence. There was, it is true, a very heavy rainfall during the year 1888, and particularly in November, and the season was unusually mild; but a local epidemic like this cannot properly be attributed to any such general influences. The cases were scattered very generally and very equally over the city. The only district which had less than its due proportion was that on the summit of the hill on the east side of the Providence River. Local unsanitary conditions, acting only on the individuals attacked, could not stand in a causative relation, as is shown by the report of the medical inspector.

The one cause which seemed most likely to act upon the whole city for the production of this disease was the water-supply. A quite common and absolutely demonstrated cause of typhoid-fever is the pollution of drinking-water with the stools of typhoid patients. Knowing the danger of pollution to which the Pawtuxet River was exposed, and thinking that the source of trouble might possibly be found along its banks, Dr. Chapin proceeded to make a thorough investigation of the river-valley. From inquiries he learned, that, with the exception of one locality, there had been only two or three recognized cases of typhoid in the valley of the river during the autumn months. The exception was at Natick. Below Natick, at Pontiac, is a dam. This is the only obstruction between the pumping-station and Natick. At the latter place are several tenements belonging to the Mill Company, situated from one hundred to one hundred and twenty-five feet from the river-bank on a flat only a few feet above the level of the water. These houses are occupied by French Canadians, and it was among them that the typhoid-fever occurred. The attending physicians — one of Natick, and the other of Centreville — could not state how this epidemic originated, but they assured Dr. Chapin that during the months of September, October, and November there had been about twenty cases of the disease in these houses, and that one or two of the patients were only just convalescent when he visited the village on Dec. 7. These people were ignorant, and no information could be gained by questioning them. They were very careless and filthy in their habits; and the attending physician stated, that, as was to be expected, they made no pretence of disinfecting the excreta of the patients. These houses were all provided with water-tight cemented vaults, situated within fifteen to twenty-four feet of the water's edge, which had not been cleansed for two or three months previous to Dec. 1, and no night-soil had been applied to any land near the river during that time.

Openings had been left in the covers of the vaults, through which it was supposed that the tenants would empty their slops; but the people chose, perversely, to throw them on the ground behind and at the side of the privies. Places were seen on the banks of the stream where these slops, mingled with fecal matter, were slowly working their way into the water. Cases of typhoid began to appear with unusual frequency in Providence about Nov. 23. As there are good reasons for believing that the incubation of typhoid-fever consumes from ten to eighteen days, and as two or three days might elapse before the disease poison was distributed at the house-taps, it is evident that the course of events was as it would have been if the rain of the 9th of November had washed the specific poison into the water.

Examinations were made of the water itself, taken from the distribution in the city, the river, and the two reservoirs. The bacteriological investigations of Dr. Swarts, the medical inspector, have made it certain that the house-filters in common use collect filth and microbes from the water, and act as incubators for the latter, allowing them to rapidly propagate within the interstices of the filtering material, and they are washed out in large numbers as water is drawn through the filter. Such filters have been invariably condemned; for it seemed certain, that, in case there were disease-germs in the water, the so-called filters, instead of removing them, would actually increase the amount of the poison, and so increase the liability to disease in those who use them. During this epidemic a large number of patients were found who had used water thus filtered; and it was especially noticeable that many of the cases which occurred soon after the epidemic proper had

ceased, made use of filters, and it is highly probable that the poison was preserved and increased in amount in these filters.

It was determined to examine these filters (taken from houses where there was typhoid) to learn whether or not they contained the specific organism. As the labor of examining such an enormous number of organisms as were found in the filters is very great, only a few filters were tested. Dr. Swarts examined some, and some were sent to Dr. T. Mitchell Prudden of the College of Physicians and Surgeons, New York, and others to Dr. Harold E. Ernst of Harvard, — all gentlemen thoroughly skilled in bacteriological work. It must be remembered that all these filters were found to be filled with decomposing organic matter, and swarming with countless bacteria. The isolation of one particular species among so many is a task of extreme difficulty, and negative testimony is of little value. Even the most skilled observers abroad have failed to detect this particular organism under similar conditions, although it was known to be certainly present. In the investigations made for this department the organism which produces typhoid-fever was not found in the water itself. Bi-monthly analyses of the water to determine the number of organisms were made on the 1st of December; but, as only a few plate-cultures were made, the negative result obtained can have little value, yet, as the epidemic was rapidly diminishing by the end of the first week in December, it is probable that there were no typhoid organisms in the water itself at the time the analyses were made. The typhoid organisms were, however, found in three of the filters. One of these filters came from the west side of the city, and the others from the east side (one from the northern, and the other from the southern part). None were on the high-service supply.

Filter No. 1, a "Star" filter, was removed from the tap Dec. 8. The patient was taken sick Dec. 1, and the filtered water had not been used for drinking-purposes since that time. There was a trap in the sink-pipe of the sink where the faucet was. There was no water-closet in the house, and the stools of the patient were disinfected and thrown into the vault. Filter No. 2, a "Grant" filter, was removed Dec. 6. The patient was taken sick Nov. 29, and died of hemorrhage Dec. 17. The plumbing of the house was complicated, but perfectly trapped and in good order. Filter No. 3, an "Aborn" filter, was removed Dec. 6. The patient was taken sick Dec. 1. The plumbing was in first-class condition; and the sanitary conditions of the house, one of the finest in the city, perfect.

There is no question that the patients who used these filters were suffering from true typhoid; and there was no chance for these filters, either while in position or after they were removed, to become contaminated, except from the water which passed through them. Besides the typhoid bacilli, several organisms characteristic of fecal matter were found in the filters, indicating the source of the specific contamination. In fact, one of the filters, so far as the organic life was concerned, resembled, as Dr. Prudden said, a mixture of charcoal, water, and human feces.

These investigations demonstrated the presence of the typhoid bacillus in our public water-supply, and also the dangerous character of the domestic filters in common use, and they also prove that the short epidemic of November and December last was due to the pollution of the Pawtuxet River by the stools of typhoid-fever patients.

BOOK-REVIEWS.

Mechanics of Engineering. [Fluids.] By IRVING P. CHURCH. New York, Wiley. 8°. \$3.

IN the preparation of this treatise on hydraulics and pneumatics, which is intended mainly for use in technical schools, the same general design has been kept in view as in the preparation of the preceding and companion work on solids. The author, who is assistant professor of civil engineering at Cornell University, has succeeded in combining clearness with consistency in the setting-forth and illustration of theoretical principles, and has provided numerous and fully lettered diagrams, in which, in the greater number of cases, the notation of the accompanying text can be easily apprehended. Especial attention is invited to the proper use of systems of units in numerical examples, the latter being introduced very copiously and with de-

tailed explanations. The results of the most recent experimental investigations in hydraulics have been taken advantage of in assigning values of the numerous co-efficients necessary to the more thorough comprehension of the subject. Among the investigations thus utilized may be mentioned those of Fteley and Stearns in 1880, and of Bazin in 1887, on the flow of water over weirs; those of Clemens Herschel in testing his Venturi water-meter; and also some recent experiments in the transmission of natural gas and compressed air. Though the action of fluid motors has not been dealt with as extensively as some might have desired, sufficient matter is given in treating of the mode of working steam, gas, and hot-air engines, air-compressors, and pumping-engines, together with numerous examples, to be of considerable advantage to students not making a specialty of mechanical engineering.

Elementary Synthetic Geometry of the Point, Line, and Circle in the Plane. By N. F. DUPUIS. London and New York, Macmillan. 16°. \$1.10.

THIS work is a result of the author's experience in teaching geometry to junior classes in the University of Queen's College, Kingston, Canada, for a series of years. It is not an edition of "Euclid's Elements," and has, in fact, little relation to that work except in subject-matter. There are a number of points in which the book varies from the majority of modern treatises on geometry. The point, the line, and the curve, lying in a common plane, are taken as the geometric elements of plane geometry, and any one of these or any combination of them is defined as a geometric plane figure. Thus, the author defines a triangle as the combination of three points and three lines, and he claims that this mode of considering geometric figures leads naturally to the idea of a figure as a *locus*. The principle of motion and the transformation of geometric figures recommended by Sylvester, and the principle of continuity, are freely employed.

The intention in preparing the work has been to furnish the student with that kind of geometric knowledge which may enable him to take up successfully the modern works on analytic geometry.

Go to the Ant and learn Many Wonderful Things. By JOHN WENTWORTH SANBORN. Cincinnati, Cranston & Stowe; New York, Hunt & Eaton. 12°.

MR. SANBORN, finding that his own children were interested in his experiments with ants, and that they asked him all sorts of questions, sought every possible means for gaining information to instruct them, and as a result of the notes put down by him from time to time, of the information gathered by observation and reading, this little book was prepared. The book tells of the social life of ants, their food, the plants which they seek, the different varieties of ants, with a chapter on foraging ants and ants as social creatures.

A Treatise on Spherical Trigonometry, and its Application to Geodesy and Astronomy. By JOHN CASEY. London and New York, Longmans, Green, & Co. 12°. \$1.50.

THIS manual is intended as a sequel to the author's treatise on plane trigonometry, and is written on the same plan. It is believed, that, though moderate in size, it contains a large amount of matter, much of which is original; the author having turned especially to *Crelle's Journal für die reine und angewandte Mathematik*, Berlin, and *Nouvelles Annales de Mathématiques*, Paris, for recent information. Professor Neuberg of the University of Liège aided considerably in its preparation.

A Laboratory Guide in Chemical Analysis. By DAVID O'BRIEN. 2d ed. New York, Wiley. 8°. \$2.

THIS volume is intended for the use of students who possess some knowledge of chemistry, and is especially adapted to the wants of the college or the medical laboratory. In the second edition we note that some of the chapters which were in the first edition have in this been greatly extended, while others are entirely new. Among the items of special interest we would mention the separation of substances by electrolysis, water analysis, and the methods for the detection of ptomaines and alkaloids.

Publications received at Editor's Office,
June 3-8.

BLAND, F. The Prophet's Mantle. Chicago, New York, and San Francisco, Belford, Clarke, & Co. 322 p. 12°. 50 cents.
CARUS, P. Fundamental Problems. The Method of Philosophy as a Systematic Arrangement of Knowledge. Chicago, Open Court Publ. Co. 267 p. 12°. \$1.
JOHNSON, W. E. Treatise on Trigonometry. London and New York, Macmillan. 504 p. 12°. \$2.25.
KERR, Alva M. Trean; or, The Mormon's Daughter. Chicago, New York, and San Francisco, Belford, Clarke, & Co. 184 p. 12°. 50 cents.
NEW JERSEY, Annual Report of the State Geologist of, for the Year 1888. Camden, Sinnickson Chew, Pr. 86 p. 8c.
SAUVEUR, L. Les Chansons de Béranger. New York, Christern; Boston, Carl Schoenhof. 228 p. 12°.

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READY THIS WEEK.

The Ice Age in North America,

AND ITS BEARINGS UPON THE ANTIQUITY OF MAN.

By G. Frederick Wright, D.D., LL.D., F.G.S.A., Professor in Oberlin Theological Seminary; Assistant on the United States Geological Survey.

With an Appendix on "The Probable Cause of Glaciation," by Warren Upham, F.G.S.A., Assistant on the Geological Surveys of New Hampshire, Minnesota, and the United States.

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The writer has personally been over a large part of the field containing the wonderful array of facts of which he is now permitted to write, but he is one only of many investigators who have been busily engaged for the past fifteen years (to say nothing of what had been previously accomplished) in collecting facts concerning the Glacial period in this country. His endeavor has been to make the present volume a fairly complete digest of all these investigations.

Although the title of the book is "The Ice Age in North America," it is really a treatise on the whole subject of the Glacial period; for, with the vast field open for investigation on this continent and the amount of attention recently given to its exploration, North America is now by far the most favorable place from which to approach the study of ice-action and ice periods.

The numerous maps accompanying the text have been compiled from the latest data. The illustrations are more ample than have ever before been applied to the subject, being mostly reproductions of photographs taken by various members of the United States Geological Survey in the course of the past ten years, many of them by the author himself.

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New Mathematical Works.

ELEMENTARY SYNTHETIC GEOMETRY OF THE POINT, LINE AND CIRCLE IN THE PLANE. By N. F. Dupuis, M.A., F.R.S.C., Professor of Pure Mathematics in the University of Queen's College, Kingston, Canada. 16mo, \$1.10.

A TREATISE ON GEOMETRICAL CONICS. In Accordance with the Syllabus of the Association for the Improvement of Geometric Teaching. By Arthur Cockshott, M.A., and the Rev. F. B. Walters, M.A. 16mo, \$1.25.

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Elementary Statics. By J. B. LOCK. London and New York, Macmillan. 16°. \$1.10.

THIS little book has been prepared as a text-book for students intending to present themselves for the Cambridge previous examination for Woolwich, for the Oxford and Cambridge certificate, and for other English examinations of a similar nature. The author has also endeavored to keep in view the importance of the subject as an introduction to the study of physics and of practical mechanics. A slight knowledge of trigonometry is needed, but considerable portions may be read without any acquaintance with this subject. The truth of the parallelogram of forces is assumed, and, like many English writers, the author bases the whole subject on Newton's laws of motion. A chapter is added on graphic statics, in which is considered the triangle of forces. The examples given are in general simple, but at the end one hundred examples of greater difficulty are inserted.

AMONG THE PUBLISHERS.

IN the first number of *The New Review*, which Longmans, Green, & Co. will issue at once, Senator Naquet, a partisan of Gen. Boulanger, states the general's case by authority, and is answered in the following pages by M. Camille Pelletan. Another burning question, "The Unionist Policy in Ireland," is discussed in the same number by T. W. Russell, M.P. Lady Randolph Churchill contributes to the June number of *The New Review*, notes of travel, called "A Month in Russia;" and another American, Mr. Henry James, supplies an article entitled "After the Play."

— Ward & Downey will publish shortly the first authentic narrative of the early proceedings of Stanley's expedition to relieve Emin Pacha, under the title of "With Stanley's Rear Column." The author, Mr. J. Rose Troup, who was the transport officer of the expedition, will give a full account of the experiences of the party left at Yambuya. His narrative will include a description of the voyage up the Kongo, the camp on the Aruvimi, and a complete diary, showing how events led up to the assassination of Major Barttelot, and the failure of this branch of Stanley's expedition.

— Messrs. Ginn & Co. announce for publication "Algebraic Analysis," by G. A. Wentworth, J. A. McLellan, and J. C. Glashan. This work, which has been previously announced as Wentworth & McLellan's "University Algebra," is intended to supply students of mathematics with a well-filled storehouse of solved examples and unsolved exercises in the application of the fundamental theorems

and processes of pure algebra, and to exhibit to them the highest and most important results of modern algebraic analysis. The work will be issued in two volumes, the first of which closes with an extensive collection of exercises in determinants.

— Cassell & Co. will publish on the 15th, Wilder's "The People I've Smiled With" and a cheaper edition of Max O'Rell's "Jonathan and his Continent."

— D. Appleton & Co. publish this week "The Ice Age in North America, and its Bearings upon the Antiquity of Man," by G. Frederick Wright, professor in Oberlin Theological Seminary, and assistant on the United States Geological Survey, with an appendix on "The Probable Cause of Glaciation," by Warren Upham.

— Houghton, Mifflin, & Co. have just published "The Beginnings of New England," a series of lectures by John Fiske; "Indoor Studies," a new volume of essays, by John Burroughs, chiefly on authors and literary subjects; and two new volumes in their Riverside Library for Young Folks, — "Birds through an Opera-Glass," by Florence A. Merriam; and "Up and Down the Brooks," by Mary A. Bamford. They will publish, in connection with Bickers & Son of London, an *édition de luxe* of Swift's works in nineteen volumes, octavo. Only 250 copies will be placed on the American market. The reprint is after Sir Walter Scott's second edition.

— *The Home Journal*, in its issue of June 12, publishes a summer-resort guide which contains facts of interest concerning summer hotels. The guide gives the features of the hotels, the number of guests each accommodates, with the tariff of charges, the distances, and how to reach the different points.

— Trübner & Co. will issue immediately the first number of a new periodical, *The Periodical Press Index*, a monthly record of leading subjects in current literature. Mr. John S. Farmer, the compiler, has indexed about 160 different publications in the first number. There will also be issued a yearly summary volume, which will include all that is contained in the twelve monthly numbers.

— The May number of the *Modern Science Essayist* (Boston) contains an essay on "The Descent of Man," by E. D. Cope, Ph.D. The June number is devoted to the "Evolution of the Mind," by Robert G. Eccles, M.D.

— Nos. VII., VIII., and IX. of the *Johns Hopkins University Studies* (seventh series) are devoted to "The River Towns of Connecticut, a Study of Wethersfield, Hartford, and Windsor," by Charles M. Andrews.

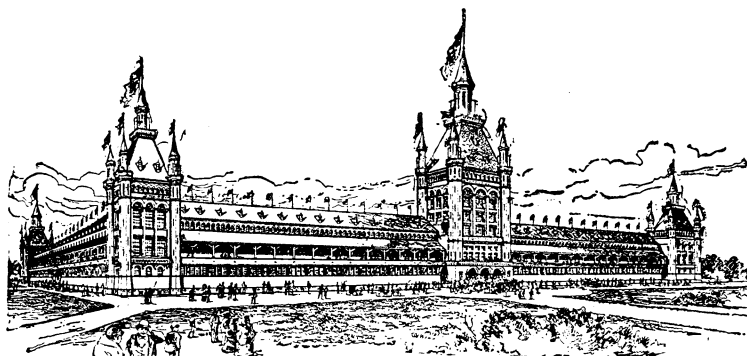
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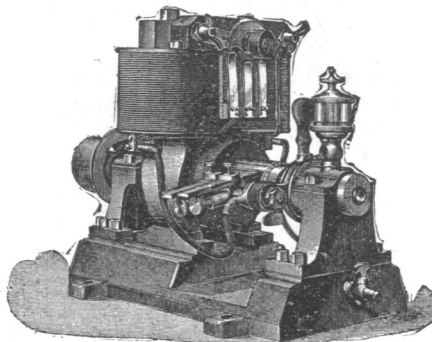
The attention of physicians is called to the report of Drs. Prudden, Biggs, and Loomis, on p. 465, and an expression of their opinions is desired, by the editor of *Science*, 47 Lafayette Place, New York, on the following points : —

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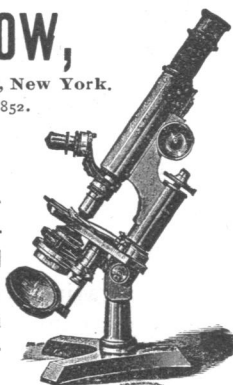
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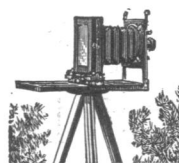
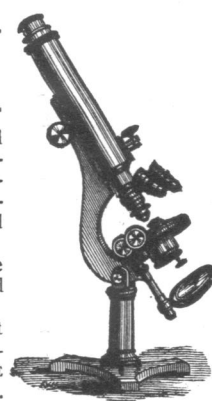
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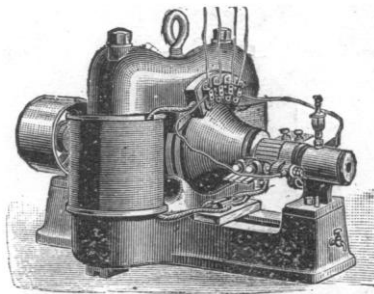
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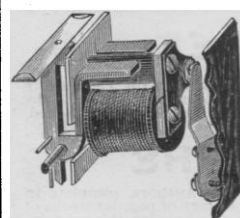
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